Acceptance of Information Technology by Health Research Projects in Low-income Countries

Intention to use and Acceptance of Using EpiHandy (IUAUE)

by

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ABSTRACT

Introduction: To better understand the data collector's intention to use and acceptance of using, Centre for International Health (CIH) University of Bergen (UIB) wanted feedback on introduction of EpiHandy, by using the PROMISE EBF Mbale site in Uganda as a pilot for collecting health data in low income countries using PDA. The aim was to uncover some of the factors influencing or affecting the intention to use and acceptance of the technology by the users of this system. **Method:** The framework of this study was a mix of quantitative and qualitative method. Background characteristics of the data collectors, observations using film camera, depth interviews and the use of structured questionnaires to find out intention and acceptance was used. Constructors like *Performance Expectancy, Social Influence, Facilitating Conditions, gender, age, experience, mandated,* and *access to technology in childhood,* and *number of errors in the technology* was used finding level of intention and acceptance. Using Davis et al. [1998] Technology Acceptance Model (TAM) founded on the Theory of Reasoned Action and Venkatesh et al. [2003] Unified Theory of Acceptance and Use of Technology (UTAUT) as baseline it was possible to observe and collect data during the field work in Uganda and South Africa**. Results**: There was almost no difference in intention to use between Uganda and South Africa, but there was indication that the data collectors feeling of being important was different. EpiHandy was well accepted by the data collectors due to many errors (50% failure) present in the technology, and lack of plans introducing the technology. The results indicated that Facilitating Conditions was the strongest constructors when it came to intention and acceptance.

Conclusion: In this study a totally new way of collecting data in a low-income country in Africa was observed. The conclusion was that the technology was well accepted and the intention to use and acceptance of using was high even when the number of errors in the technology was high. This indicates also that the EpiHandy technology will b highly accepted in South Africa and probably at the other sites in the PROMISE EBF study as well. Acceptance of Information Technology by Health Related Projects in Low-income Countries was high despite lack of introduction plan, and many errors in the technology.

PREFACE

This Master Thesis is as a finalization of the Master Study in Information and Communication Technology (ICT) at Agder University Collage Faculty of Engineering and Science. Before entering the Master Program at Agder University Collage I had work experience from Siemens Norway AS and Telenor Telecom Solutions, as system engineer and field engineer. My wife, Ingunn's engagement as a PhD student at Centre for International Health (CIH), University of Bergen (UIB), has given me more insight to health research and important contacts in this field. The access to the EU sponsored multi centre cluster randomised intervention study called PROMISE EBF was essential doing this study. PROMISE EBF is one of the first studies using EpiHandy software developed at CIH. With my background as an engineer I got interested in this new technology. In order to evaluate this I travelled to Uganda for fieldwork from March to August 2005 during their piloting.

I want to thank my contact person at CIH, Jørn Klungsøyr for having developed EpiHandy. I also want to thank Professor Thorkild Tylleskär, the main coordinator of the PROMISE EBF study for facilitating my field work and being very supportive to this study.

I want to thank my supervisor Professor Per Egil Pedersen at Agder University Collage for valuable guidance during the design, study period and writing of this thesis. I also have to thank the Ugandan site-coordinator Professor James Tumwine and the Mbale coordinator Dr Nulu Semiyaga for their support. Lastly I want to thank my wife Ingunn for inspiration and much help during field work in Uganda. And not to be forgotten; if it had not been for the data collector's always supportive and positive attitude, this study could not have been done.

Grimstad 12th Desember 2005

Terje Engebretsen

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LIST OF ABBREVIATIONS AND DEFINITION OF TERMS

- **Acceptance of technology**, technology introduced when it has proven capable of being accurate and reliable, and then investigated with measurements related constructors like e.g. perceived usefulness.
- **AIS**, Association of Information Systems
- **Anthropometrical**, the systematic collection and correlation of measurements of the human body.
- **CIH**, Centre for International Health
- **C-TAM** Content-Technology Acceptance Model
- **DSS**, Demographic Surveillance Site
- **DTPB**, Decomposed Theory of Planned Behaviour
- **EBF**, Exclusive Breast Feeding
- **EEC**, Efficiency, Effectiveness, Competitiveness
- **Epidemiological**, the study of the distribution and determinants of diseases.
- **EpiHandy**, software application used for collection of health related data.
- **EU**, European Union
- **GDP**, Gross Domestic Product
- **Good Start II**, The South African part of PROMISE EBF study
- **GPS**, Global Positioning System
- **GSM**, Global System for Mobile Communication
- **HCI**, Human Computer Interface
- **HDR**, Human Development Report
- **HIV**, Human Immunodeficiency Virus
- **IDT**, Innovation Diffusion Theory
- **INGO,** International None Governmental Organisation
- **Intention to use technology**, intention to use technology can mean the mind knowing or having knowledge of technology planned to be introduced, and by using measurements to find out use of perception for the act of perceiving or for the thing perceived.
- **IS**, Information System
- **ISI**, Web of Knowledge, search tool to find articles

- **ITANA**, Information Technology in the Advancement of Nutrition in Africa
- **IUAUE**, Intention to Use and Acceptance of Using EpiHandy
- **Low income countries**, "*The usual definition of a developing country is that adopted by the World Bank: "low-income developing countries" in 1985 were defined as those with per capita incomes below $400" per year.*
- **MPCU**, Model of PC Utilization
- **MTN**, South African Mobile telephone operator in Uganda
- **PC**, Personal Computer
- **PDA**, Personal Data Assistance
- **PROMISE EBF**, Promoting Infant health and nutrition in Sub-Saharan Africa
- **Pubmed**, Public search database on health related literature and articles
- **SES**, Socio-Economic Status
- **RUP**, Rational Unified Process
- **SIDA**, Swedish International Development Cooperation Agency
- **SPSS**, a fourth generation programming language with applications for statistics, graphs, and reports.
- **SQL**, Structured Query Language
- **Technology**, Mobilelient software on PDA, PDA and GPS module (used by data collectors)
- **TAM/TAM2**, Technology Acceptance Model
- **TPB**, Theory of Planned Behaviour
- **TRA**, Theory of Reasoned Action
- **UIB**, University of Bergen
- **UN**, United Nations
- **UNCTAD**, United Nations Conference on Trade and Development
- **UNDP**, United Nations Development Program
- **UTAUT**, Unified Theory of Acceptance and Use of Technology
- **UTL**, Uganda Telecom LTD
- **WHO**, World Health Organisation
- **Z-scored**, WHO International growth reference, specified anthropometrical measures

1 INTRODUCTION

Due to a high illiteracy rate in low income countries the traditional interview situation has been and still is the most common method to collect data [UNCTAD]. If it is a community based study, this implies that data collectors have to physically visit the participant's location to execute the interview and carry the information back to the site office. Health related data collection is often preferred collected in health centres to decrease the logistical challenges. But, the drawback is that this might in many settings cause selection bias and interview bias [Fowler, 2002], [Egger and Schneider, 1997]. Where the study question demands a community based study which is often the case with a behavioural intervention or in a survey, physical visits with paper and pencil is today's state of the art. In the latest years there have been developed new tools to enter and code the data from paper questionnaires e.g. software which recognise handwritten letters and numbers. This method demands big quantities of data, high knowledge of maintaining it, and of course it is a very expensive technology to use. In our western setting this is used in a big scale and even the study participants might fill in the questionnaires themselves [The Norwegian Institute of Public Health, Den norske mor og barn-undersøkelsen]. Another solution in health related studies where selection bias is not a big concern; different software is developed for stationary computers [www.surveysystem.com]. When it comes to handheld computers called PDA (Personal Data Assistance) the situation is different. There are not many solutions around, but one of them is QDS (Questionnaire Development System) by MRC SA [Medical Research Centre South Africa] being a fully commercial application developed specifically for collecting data in the fields [www.novaresearch.com] and EpiHandy [www.epihandy.com]. The developer of EpiHandy Jørn Klungsøyr got inspiration from QDS, but there are some essential differences. Firstly the EpiHandy has open source code [Vishwanath et al., 2002]. Secondly it can be used without paying licence. Thirdly the design of questionnaires are suppose to be done by the respectively research teams and not by the supplier or the developers of the application.

Research projects with limited budget can not afford high-end technology equipment where they have to pay for expensive equipment, software, and support. They need cost effective equipment which they can afford. When the hardware and

software together challenge the price of paper printing, copying, double data entry, and in addition benefits data quality many are interested [Klungsøyr, ITANA Conference 2005]. When an increased amount of data rather decrease the computer and stationary costs study and not add on costs, the sample size might affect a project's choice whether they go for digital or paper data collection. At a certain number of questionnaires the digital might be cheaper than the traditional paper. I will from here on continue only focusing on the EpiHandy software.

CIH believe that the EpiHandy concept of collecting, storing and coding the data almost on the spot is supposed to be a more cost effective and time efficient method compared to paper [Ryan et al., 2002]. Finding studies which have been looking at health projects intention and acceptance to use technology in low income countries seems to a bit be scarce, and the evaluation of how to execute field studies looking at technology like portable equipment in this context is not carried out that often [Kjeldskov and Graham, 2003].

1.1 THE DEFINITION OF THE PROBLEM AND STUDY DESCRIPTION

The study problem is related to introduction of new technology within the field of health research in developing settings. In this study, Sub-Saharan countries, more specifically Uganda and South-Africa represents these settings, and EpiHandy MobileClient-software, PDAs, and GPS (Global Positioning System) represent new technology. In this chapter a general overview of the problem is firstly given. Later on details on what was investigated.

The purpose of this study was to investigate the intention to use and the acceptance of using EpiHandy, more precisely meaning data collectors intention to use and acceptance of using the PDA, Epihandy MobileClient software and GPS in the piloting of PROMISE EBF (Promoting Infant health and nutrition in Sub-Saharan Africa) study in Uganda and South-Africa March to August 2005.

CIH's motivation for developing Epihandy was to get an effective and precise way to collect data. This also implies they believed the software should have a high intention to use and acceptance of using by the data collectors in the PROMISE EBF study. For all researchers involved and the data collectors, the developers thought the software should be intuitive to use with a low to moderate background with normal PCs (Personal Computer).

A multi centre study called PROMISE EBF including Burkina Faso, Uganda,

Zambia and South-Africa is ongoing. The actual data collection period was planned form autumn 2005 and preparation for implementation has been an ongoing process beforehand. Centralized piloting was to be started in Uganda in March 2005. The piloting was the time to find out some indications about the anticipations and qualified guessing about the technology. Is everything CIH anticipated, true? Is it intuitive to understand and to learn, how is the intention to use, and is the technology going to be accepted?

In spring and summer of 2005, Ugandan rainy and dry season, two separate health related research projects were conducted in Eastern Uganda in two different districts; Iganga and Mbale. Both sites were introducing EpiHandy, PDA and GPS technology for collecting data during the interview situation. In Mbale the PROMISE EBF is run. The Ugandan collaborator is Dept. of Paediatrics and Child Health, Makerere University. The Ugandan site coordinator is Professor James Tumwine Dept. of Paediatrics and Child Health, Makerere University. As mentioned earlier Professor Thorkild Tylleskär, CIH is the main coordinator of the overall project. Figure 1 on page 4 is a simplified overview of the PROMISE EBF and the Intention to Use and Acceptance of Using Epihandy study (IUAUE).

The project in Iganga called Iganga/Mayuge DSS (Demographic Surveillance Site) [INDEPTH] supported by SIDA (Swedish International Development Cooperation Agency) and is coordinated by PhD Stefan Peterson, visiting Professor at Makerere University, Kampala. From March 2005 they had already collected large amounts of data, and they will continue collecting data in the years to come. The DSS site planned to introduce EpiHandy as the tool for collecting data, but due to many errors in both hardware and software and missing functionality during introduction, it was decided to postpone it to October or November 2005. The Iganga DSS was intentionally one of the study sites for this intention and acceptance study, but because of the technical delay in their data collection using EpiHandy, most of the data was collected in Mbale as far as Uganda is concerned.

Three different study sites in South Africa also contributed to the study on intention and acceptance. This includes Paarl in the Cape region, Rietvlei and Umlazi in Kwa Zulu Natal. They were all part of the PROMISE EBF study, but to complicate the picture even more; the same study is called Good Start II in South Africa. The South African coordinators consist of Ass Prof Debra Jackson, Tanya Doherty, Mickey Chopra and others. Many other senior researchers are also involved

in the PROMISE EBF study including Halvor Sommerfelt, Rajiv Bahl, David Sanders, Philippe van de Perre, Chipepo Kinsasa among others.

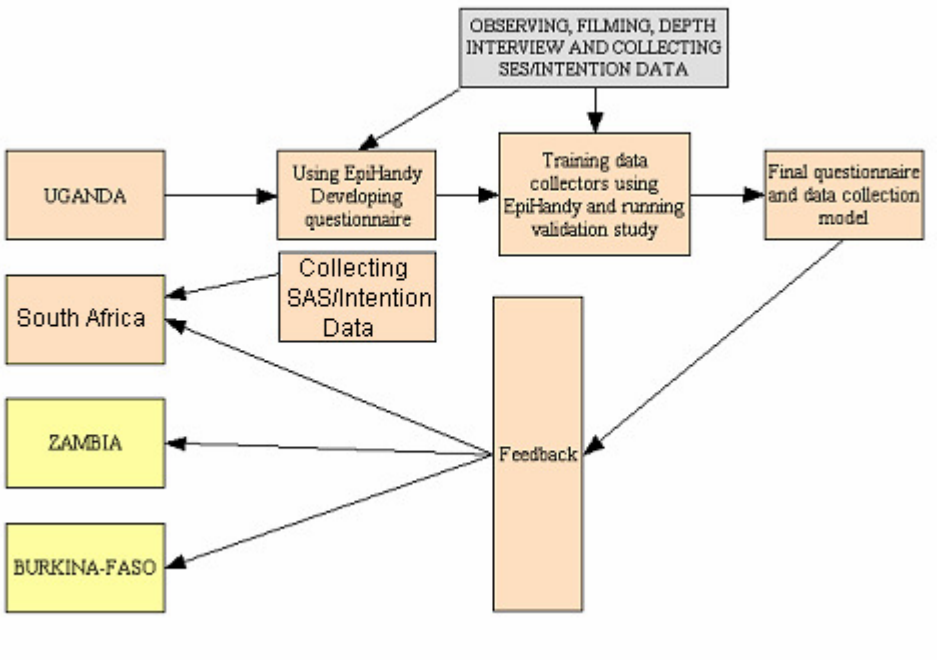


Figure 1. Overview of the IUAUE (Intention to Use and Acceptance of Using EpiHany)-study within the PROMISE EBFstudy.

In the IUAUE (Intention to Use and Acceptance of Using EpiHany) study we wanted to evaluate the implementation of EpiHandy with the focus on data collectors use of PDA and GPS.

1.2 DELIMITATIONS

Mbale District representing the Ugandan site in the PROMISE EBF-study was chosen to do the first main piloting of the instruments including using EpiHandy, the data collection tool. The piloting in Uganda was run part of a validation study of the instruments making up approximately 430 interviews over 3 months. The PROMISE EBF-study will also use EpiHandy as the data collection tool in Burkina Faso, Zambia, and South-Africa too, but Burkina Faso and Zambia did not start their training of data collectors within my study period and were therefore excluded from the study. South Africa started their introduction of EpiHandy at the end of my study period and the structured questionnaires on background characteristics and intention to use were therefore distributed in that data collector team after they had undergone

the same one week introduction similar to what the data collectors at Mbale site in Uganda did.

Personally I was only present at the Mbale and Iganga sites in Uganda. Through the PROMISE EBF study team I managed to collect data from South Africa too as mentioned above. The timeframe of this master thesis together with a limited budget, predetermined to which extent I could study EpiHandy.

The project leaders, site coordinator and designer of the questionnaire were also using PDA and GPS in order to test new functionality. They were only observed reporting errors in the technology and software used.

The lack of personal national registers like social security numbers and private addresses, force individual research projects to have procedures taking care of identifying geographical areas, villages and individuals. This functionality in EpiHandy was not evaluated in this thesis, nether are the methods used to keep the collected data safe with respect to identification of individuals, protection of the integrity and data security.

Different modules of the EpiHandy software concept was not yet developed, or under development during the study period. Other concepts were not applicable for evaluating the intention to use and acceptance of using by data collectors. Therefore limitations were necessary concerning some part of the software and functions in the EpiHandy.

The following parts were not studied as the software was to immature to be tested:

-Data Entry Client, used to make changes to collected data in the database

-Centralized database, storing all collected data for all sites

-Web Client

-Email Client

-Local SQL, database holding the collected data locally

-StudyManager, for designing questionnaires, and not used by data collectors

The following parts were not studied as they are well established word standards:

-MS-SQL

-PDA technology specifications

-GPS technology specifications

This thesis will not evaluate the quality of the open source code in EpiHandy, because it belongs to another problem area concerning standardisation process and not the area of IS (Information Systems).

Other parts of the EpiHandy technology called Nutrition Calculator can be used to determine health and nutrition status of the interviewee, children and other household members. The anthropometrical status including weight for age, height for age and weight for height with z-scored is a part of the medical area and not IS and was therefore excluded from this study. The Nutrition Calculator is also part of a concurrent collaboration process between the EpiHandy developers and WHO (World Health Organisation) Antro.

1.3 JUSTIFICATION OF THE STUDY

The PROMISE EBF study sites Mbale, South Africa and Iganga DSS site was one of the first sites planned only to rely on EpiHandy technology during data collection. The study was conducted because of the following justifications:

1. It is not done before
2. Important for the actual big important study (Promise EBF and Iganga DSS)
3. External validity in developing settings
4. Important for developers
5. Important for WHO and UN
6. Important to investigate in the aim context
7. Benefiting the people living in recourse poor settings
8. Improve the user friendliness, intention to use and acceptance of using EpiHandy
9. Uncover errors in hardware and software
10. Making the users of EpiHandy more skilled using technology
11. Indirectly improve WHO guidelines on which technology to use
12. Increase the knowledge of introducing technology in recourse poor settings

1.4 AIM

The aim of this study was to find the intention and acceptance by data collectors using EpiHandy technology, to give feedback to the EpiHandy developers about problems when it was used by data collectors, and also contribute to quality increase which will benefit the PROMISE EBF study when it comes to implementation.

In addition the aim was that the IUAUE study also will add some new information about problems related to individual background characteristic which can be of hindrance or beneficial when new information technology is introduced in low income countries, and if it influence the intention and acceptance.

Another aim was to find out if it was any difference in intention and acceptance at the different sites and countries.

The aim was also to investigate whether the use of PDA compared to paper questionnaire increase the field workers use of English questionnaire compared with questionnaire translated into local language. Lastly I wanted to find out if there was any time to save conducting interviews using PDA compared to the use of paper questionnaire in the interview situation, and if the errors in the technology influenced the level of intention and acceptance.

1.5 TECHNOLOGY INTRODUCED

CIH decided to use Jørn Klungsøyrs Epihandy software, being a part of his Master in 2003 and develop this farther. In addition, Thorkild Tylleskär decided to use the EpiHandy application in PROMIE EBF.

Figure 2 on the next page show a simple overview of the EpiHandy concept and the idea behind it. In order to understand the complexity of EpiHandy technology being used in PROMISE EBF it is made a visual overview in figure 3 on page 8.

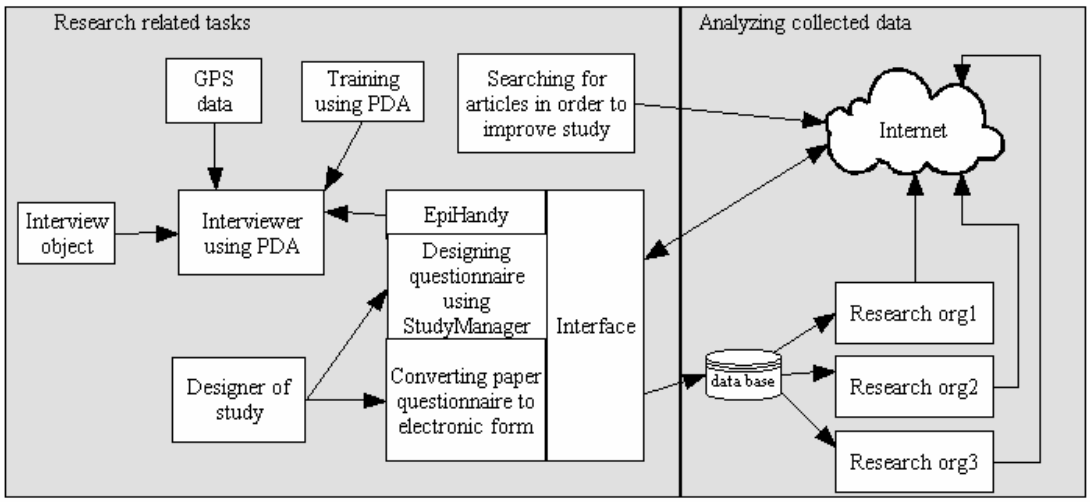


Figure 2. The Concept of the Epihandy Technology

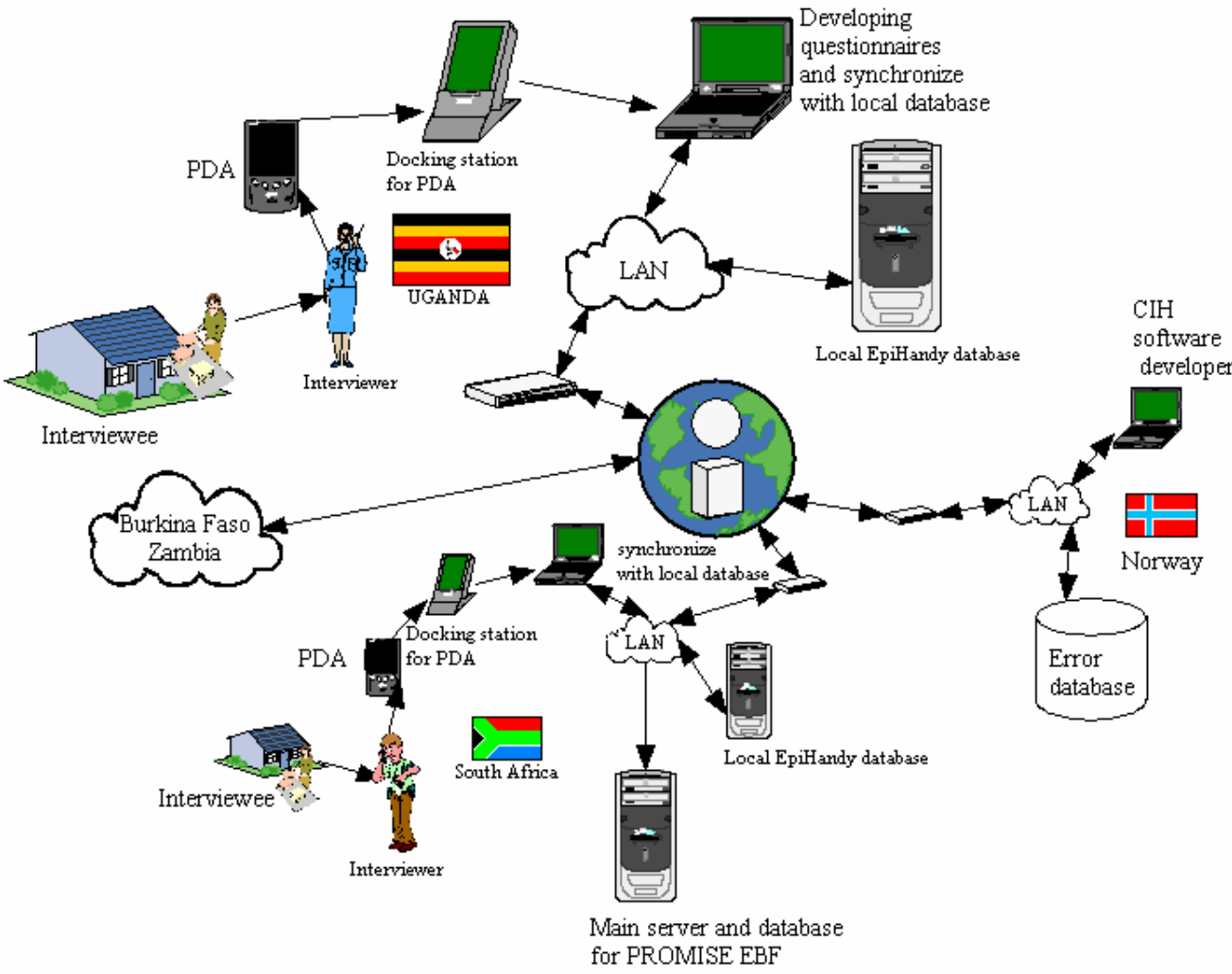


Figure 3. EpiHandy Technology used in PROMISE EBF

In Annex B it is screen shots of how the design tool (EpiHandy StudyManager) looks like. Annex C contain screen shots of the PDA (MobileClient) visualising exactly what the data collectors saw and how the final result looked like when it was ready to bee used for colleting data by fieldworkers. All the different types of questions which were available are listed in Annex D.

EpiHandy technology used in Mbale was a combination of software (MobileClient), standardised handheld computers from Hewlett-Packard (HP)/Compaq called PDA with Windows Mobile operating system, together with standard GPS, Global Positioning System modules produced by Garmin [Annex D] and standard Microsoft-SQL database, receiving the data from the PDA. Figure 4 below show the complete infrastructure of EpiHandy technology, how it is planned to be when it is fully developed for the PROMSIE EBF study.

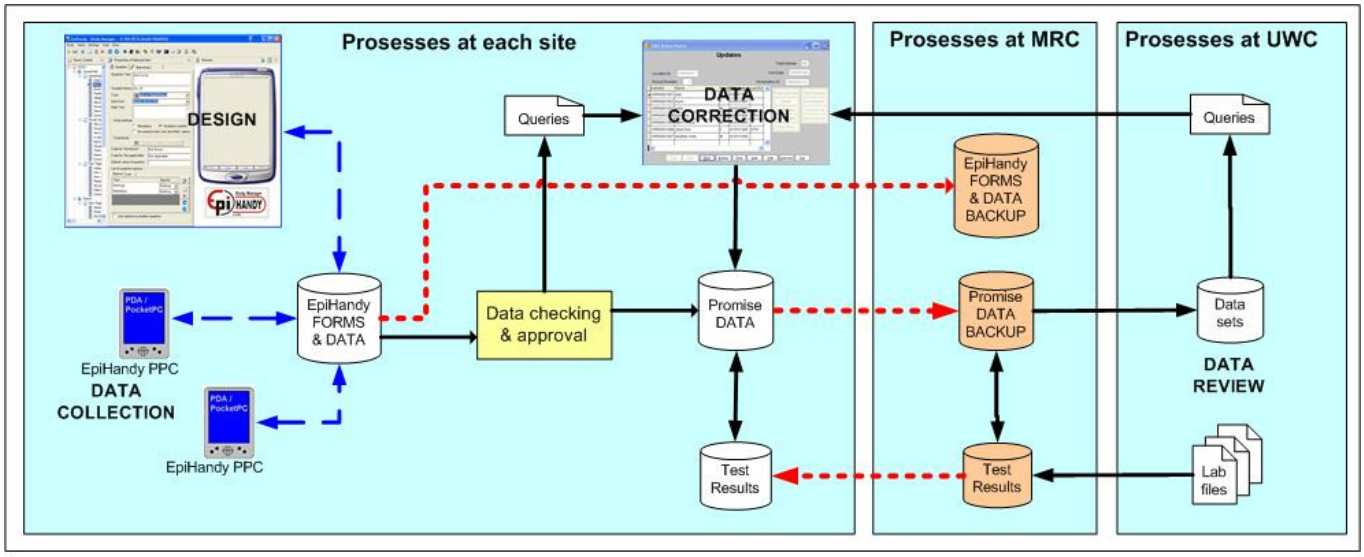


Figure 4. EpiHandy Infrastructure, Data Management and data flow, [source: www.epihandy.com, and CIH]

The process using the EpiHandy technology will be like the following:

-Designing the needed questionnaires using StudyManager and storing them in the data base holding forms and data.

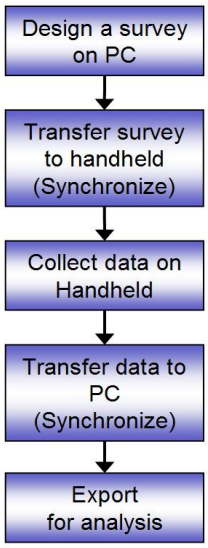
-Downloading the questionnaire to the EpiHandy Pocket PC (PDA) used by the data collectors for collecting data.

-All data are checked, approved and perhaps corrected in case of discovered

errors by the site coordinator before sending them to the centralised PROMISE EBF database in South Africa using Internet and encryption of the data.

-All local stored data are then transferred to the main data base using the Internet where the data sets are extracted from and data can be reviewed and files created for analysing. Table 1 below show the EpiHandy process and how it was done during data collection in Uganda.

Table 1. EpiHandy Process [source: www.epihandy.com]

EpiHandy consists of several interrelated programs including industry standard SQL databases for storage of data	**The process of develop a survey using the different components in EpiHandy, PDA and GPS modules**
EpiHandy-StudyManager: Design and manage your surveys	
EpiHandy-MobileClient: ClientCollect information with handheld computers	
EpiHandy-WebClient (Planned): Collect information on any computer with an internet browser.	
EpiHandy-E-mailClient (Planned): Collect information through email distribution of questionnaires	
EpiHandy – DataEntry(Planned): Double data entry of paper forms with validation on Desktop PC	

Practically, data collectors entered data using the pen tapping on the PDA sensitive screen according to the respondents answer (figure 5 on page 11). The data collector follows the questionnaire [Annex C] tapping the answers and is not concerned of keeping track of rules and skip instruction according to the answers given like they have to using paper. The application is taking care of enabling and disabling questions automatically according to the designer's intention and rules.

The GPS module can easily be physically connected to the PDA for transferring global positioning data into the questionnaire automatically [Annex D] or it can be tapped in manually like in figure 6 on the next page. Detailed pictures of the hardware used, PDA and GPS are presented in Annex E.

Figure 5. Data Collector Using PDA during Interview

Figure 6. Collecting Geographical Data from GPS after the Interview

1.6 REPORT STRUCTURE

The body of this thesis continues from here with the following:

- How the literature review was done; which databases were used and the keywords used to find relevant literature.
- Theory and Model; the results of the literature review in addition to present the chosen theory and model used in IUAUE and an overview of the study design and how the data was collected.
- Results; evaluation of quantitative and qualitative data.
- Discussion Conclusion; the results and findings in the study are commented and the most important findings are discussed, and summarised.

2 THEORY

The main focus of the literature review was to increase the understanding of. 1) Background knowledge about methods to implement new technology, what kind of effect it might have on individuals or groups, and what the technology might contribute with in the context it is introduced, and understand what influence the intention to use and acceptance of using technology, especially PDA. 2) Dedicate information and learn from earlier studies on how to conduct field study, designing questionnaires, making depth interview and analyzing and present collected data. 3) Learning how to use different tools to search for literature and research methods, and how to write, present scientific data.

The following data bases were used to find literature:

- ACM
- IEEE
- ISI
- PubMed
- Science Direct
- UN
- UNCTAD
- WHO

The following Internet search engines were used to find literature:

- Google
- Scholar Google

Key words used during literature review was, *Handheld, PDA, personal digital assistance, minicomputer, health, acceptance, information technology, intention, low-income country, developing, Uganda, software errors,* and *new technology.*

To understand why people accept or reject information technology Davis, Bagozzi, and Warshaw [1989] proved that this is the most important and challenging issues. Herbert and Benbasat, [1994] found that 77% of the variance of intention to use information technology could be explained by attitude. No matter how organised or planned the implementation is, or how sophisticated the technology is, in the end it is all depended on how positive the user's attitude is.

Studies using handheld electronic data collection or assistance collecting

survey data were found. Some studies were executed outside the field of health in developing countries and some inside.

Nusser, Thompson, and DeLozier [1996] stated that using PDA with proprietary developed software require a mobile work force and the technology is easily adopted to simpler survey environment, and is especially true for observations rather than human interviews. However Forster and Snow [1991] showed it was possible to conduct a study for simple in-person health survey even in a developing country stating that the technology might have a useful role in providing accurate and rapid information, and in addition increasing the quality of the health data. Forster and Snow [1995] showed in addition that the technology could manage a more complex survey.

Kjeldskov and Graham suggested in a study from 2003 that underlying assumption in many studies is that the problems the users face are already known and the research problem is to build the system. This can mean that the research is to technology driven making the research to understand the users suffer. They indicate farther that too many studies are done in laboratory and not in natural settings, and user centred methodology is in its infancy.

Newer studies on comparing PDA and paper like the one done by Villordon, Franklin and LaBonte, [2004] found that PDA assisted data collection is potentially useful in remote settings doing repeated data collection in several locations, and where site specific data are going to be merged into one centralised database were standardised measurement and observations are essential for performing the analysis. The accuracy of comparing collected data using PDA and current standardised practice (paper-based case report form with double data entry) was done by Missinou et al. [2005] in rural Gabon, Kenya. They found that the rate of discrepant entries was 1.7%, and that the PDA and paper systems worked smoothly without data loss, and that in general the handheld computer was preferred among the users.

Smaller case studies like the one done by Santos et al. [2002] in a remote location in Brazil found that the solution of replacing paper questionnaires with handheld computers did not give any significant advantages because the technology needs infrastructure and organisation behind it. They also stated that the amount of collected data was a limitation making the use of handheld computer not efficient, and it looked like the technology is more fit when big amount of data are going to be

collected. Even on individual collection using PDA during interview, they found that the technology did not save any time making the collection faster.

Grudin presented in to studies from 1994 and 1997 how projects and organisations are influenced using groupware, and how the social changes might be when technology going to be used by many users at the same time was introduced.

Lu et al. [2005] stat that better designed hardware and software are more likely to promote greater acceptance and adoption of handheld computers in health care, and presented results using four sections: *System characteristics*, *Benefits*, *Adoption* and *Barriers* by use of published articles from 1998-2004 using Davis TAM as framework for categorising them. Design of acceptable technology is not directly a part of this study but it is an important factor when new technology is going to be introduced, and how to understand some of the collected data. This chapter continues thereafter with theories on intention and acceptance, socio economic status, handheld computer, and observation. Research hypotheses finalise this chapter with explanation of the constructors in the conceptual research model (figure 9 page 29).

2.1 THEORETICAL APPROACHES TO THE DESIGN OF ACCEPTABLE TECHNOLOGY

To understand implementation and use of technology in organisations or projects from a broader view than only using models mentioned earlier, Constant, Kiesler, and Sproull [1994] stated that the success of communication technology for information sharing depends upon how people share them, and that each individual have different view [Checkland, 1981]. Socio-technical System Theory of Acceptance [Trist et al.] is a useful tool to understand the process during introduction of new technology, and it shows the importance to focus on the user as early as possible in the developing process. The goal is often the driving force instead of dealing with people issues. Human-centred design [Cooley, 1989], and [Pain et al., 1993] divide the process into three terms*: People*, *Organisation* and *Technology,* these terms are being used to understand the behaviour of technological systems, and are relevant in different context like individual work, cooperation in groups or networks [Rosenbrock, 1990], [Rauner, Rasmussen, and Corbett, 1987].

Baecker et al. [1995] and Price et al. [1993] state that Human-Computer Interaction (HCI) is strongly connected to the acceptance and use of technology, and

is dealing with human interfaces like mouse, screen sizes, keyboards, and design of ergonometric. One last implementation or process-model widely used is RUP, (Rational Unified Process), being a guideline when it comes to develop technology having in mind that the user is not forgotten in the developing process.

Some of this theory seeks to provide insights to those who will adopt technology that might influence groups and individuals. How ever, theory shows that prediction of how anyone or how groups accept technology is not province of diffusion theory. By using UTAUT, this question is more properly answered. It is therefore important to observe and catch attempts to influence the development of the technology in an early stage initiated by the users in order to minimize resistance and maximize the potential of acceptance by users and groups of users.

2.2 INTENTION AND ACCEPTANCE

Davis (1986) suggested that using the Technology Acceptance Model (TAM) measuring parameters like *Perceived Ease of Use* and *Perceived Usefulness* primarily could be used to find the users acceptance when new technology was introduced. Farther he defined that *Perceived Ease of Use* is in what degree a user believe that using the technology will increase their work performance, and to which degree a user believe that using the technology leads to less effort doing the same work. (Figure 7 page 17). Some have stated that TAM has some limitations and needs to be modified adding some more parameters [Zakour, 2004]. Zakour stated that TAM missed out individual culture which might influence or predict use of information technology. TAM was extended and containing six cultural value-dimensions: *power distance, masculinity/femininity, uncertainty avoidance* [Hofstede, 1997], *monochromic/polychromic time* [Trompenaars, and Hampden-Turner, 1997], and *high context/low context* [Hall, 1989].

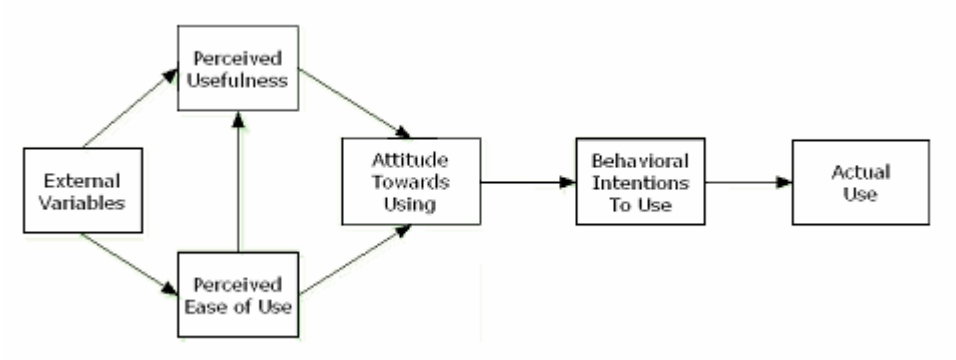


Figure 7. Technology Acceptance Model TAM [source: Davis et al. 1989]

A Methodological Analysis of User Technology Acceptance at Hawaii International Conference on System Sciences, 2004, stated: *"explore the existing inconsistencies in prior research on TAM"*. Several researchers started to question the generalisation of TAM [Straub, et al, 1995, Taylor and Todd, 1995b, and Venkatesh, and Morris, 2000].

Looking at newer models in addition to Davis et al. dealing with intention and acceptance of using technology was necessary. The subjective norms in TAM are not taken care off; therefore TAM was developed farther into TAM2 by Venkatesh, and Davis [2000]. Since EpiHandy was mandated technology is TAM not that useful when it comes to constructors like *Perceived Ease of Use* and *Perceived Usefulness* because they have no significance in mandated settings or no meaning. Venkatesh et al. [2003] stated it was possible to construct a unified view on how to investigate the acceptance of technology and likely to become classic way of doing research within this field. This model combined eight earlier models which were traditionally used to investigate intention and acceptance.

Venkatesh et al. [2003] suggest farther research should try to come up with and identify new constructors that can contribute with farther development in the area of prediction of intention and behaviour to add on what is already known. At the same time it could be that the limit of finding new constructors have been reached, and therefore it can be hard to find new on individual acceptance, intention and usage decision in organizations.

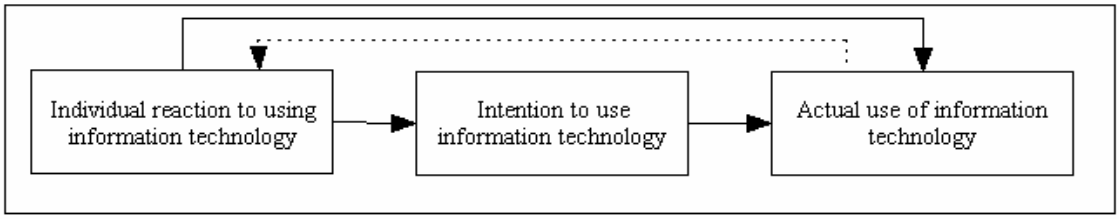


Figure 8. Basic Concept of the UTAUT [source: Venkatesh et al. 2003]

2.3 SOCIO ECONOMIC STATUS

Information about the participant background was investigated looking at *ownership of technological assets*, *salary*, *age, using mobile phone, using Internet* (table 3 on page 38 and 39). This selection of covariates is based on Lundberg et al. [2004], and is a well acknowledged way to collect background information.

2.4 HANDHELD COMPUTER

Related studies using handheld computers, McBride et al. [1999] show that there are no significant differences in the collected data using PDA or paper; and it can be looked upon as equal methods, but there is indication of interference between the interviewer and he interviewee. The indication of interference between interviewer and interviewee say Houston et al. [2003] is caused by the negative interviewee's attitude towards handheld computers, and even among the interviewers it was some reservation using the handheld. Ryan et al. [2002] found that using PDA instead of paper was some how faster. Villordon, Franklin, and LaBonte [2004] indicate that using PDA collecting data remotely is particularly useful when the data is going to be centralised in one database. Without any system behind, a study from Brazil done by Santos et al. [2002] indicated that using PDA is probably not adequate for the reality observed in remote health centre, the reason can be that the health system is used to paper forms instead of electronically data, and that the amount of information data collected was to small. The data collectors are used to paper and pencil collecting data, therefore using a PDA might not be that different, and Negroponte [1995] suggest that the perfect metaphor for a computer interface is a piece of paper and a pencil, because people are all ready skilled using these devices.

2.5 THEORETICAL APPROACH DOING OBSERVATION AND INTERVIEW

From theory presented by Leedy, and Ormrod, [2005] on how to do observation and depth interview during field study, it was possible to prepare doing observations and interviews. They also indicate that there is no final answer how to make qualitative studies. Sometimes just being present in the working environment of what you are observing can be helpful designing the study.

2.6 RESEARCH HYPOTHESES

The hypotheses within the research problem were based on Technology Acceptance Model, Davis et al. [1989] and the Unified Theory of Acceptance and Use of Technology Venkatesh et al. [2003]. From these models it was possible to design a conceptual framework of the IUAUE study as shown in Figure 9 on page 20, and state the following hypotheses within the definition of the research problem:

H0 (Null hypothesis): *Intention to use and acceptance of using EpiHandy is not influenced by the number of errors in the technology being introduced*.

In daily life, the data collectors are somehow presumed to be used to errors or bad quality on infrastructure, mobile phones, and computers. Therefore, it is assumed that the tolerance for errors in the EpiHandy technology is not influencing the acceptance and intention to use the technology.

H1: *Intention to use and acceptance of using Epihandy is influenced by the number of errors in the technology being introduced*.

H2: *Intention to use EpiHandy technology and acceptance of using it are functions of the following: Performance Expectancy, Social Influence, and Facilitating Conditions*. Usually when new technology is introduced to individuals, the immediate response of how useful the technology is compared to the complexity of using it is essential for level of acceptance or intention to use.

Related to the technology itself are questions like how easy is it to learn, understand and use while working, and are the functions logical? *Performance expectancy* is defined by the degree of how an individual member of the project believes that using EpiHandy will help to gain job performance. *Social Influence* is the degree to which an individual perceives that important others believe he or she should use the new system, and *Facilitating conditions* is defined by the degree of what an individual believe that the organisation or project has concerning support during use of the system.

H3: *Individual background, motivation and gender influence the attitude of intention to use EpiHandy technology and acceptance of it*.

Individuals using new technology have some expectancy of how well they think they will manage to use it after being introduced to it or after being trained to use it. The motivation is important in order to use, and learn how to operate the new technology. Due to some differences in background in for example childhood and education the attitude of using the technology can vary.

H4: *Using PDA instead of paper will increase the use of English questionnaires during the study compared to local language*.

When a data collector uses PDA he or she has to choose whether to use the English or the translated questionnaire before doing the interview. It means that the flexibility which the paper questionnaire gives might be gone.

H5: *The use of PDA will decrease the interview time making the data collector's intention to use and acceptance of using EpiHandy higher*.

There is evidence in the literature that it is slightly faster to use PDA instead of paper during the interview situation. In addition the feeling of being able to execute interview more quickly influence the intention to use the technology and the acceptance.

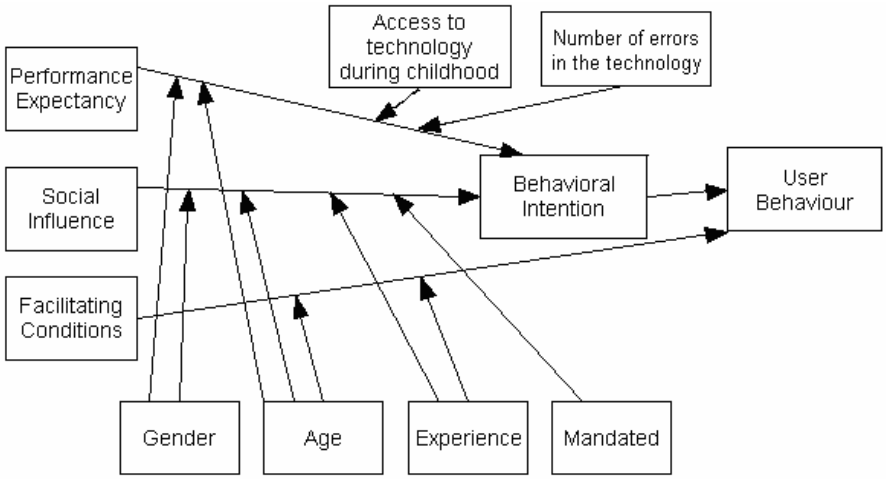


Figure 9. Conceptual Research Model based on [source: Venkatesh et al. 2003]

In the following chapter's 2.6.1-2.6.9 the conceptual research model shown on previous page is described, their meaning, where they are taken from, and what they contribute with in the study.

2.6.1 Performance Expectancy

The Performance Expectancy is defined as the degree to which an individual believes that using the system or in this case EpiHandy technology will help him or her to attain gains in job performance [Venkatesh et al., 2003]. Earlier models and the most common relationship between them is described by Venkatesh and he uses *Performance Expectancy* as a common constructor for all earlier models, being Perceived Usefulness (TAM/TAM2 and C-TAM-TBP), Extrinsic Motivation (MM), Job-fit (MPCU), Relative Advantage (IDT) and Outcome Expectations. Venkatesh also showed that Performance Expectancy is one of the strongest predictors of intention and remains significant at all points in both voluntary and mandatory settings. In addition, gender and age are also expected to influence this constructor, because research on gender differences indicates that men are more task-oriented [Minston and Schneider, 1980] than women, and age in job-related settings indicate that younger workers may place more importance on extrinsic rewards [Hall and Mansfield, 1995, Porter, 1963]. Gender and age has also shown to be present in technology adoptions [Morris and Venkatesh, 2000].

2.6.2 Social Influence

Venkatesh state that Social Influence is defined as the degree to which an individual perceives that important others believe (influencing people close to you) he or she should use EpiHandy technology. In order to find a unified construct on subjective norms Venkatesh looked at TRA, TAM2, TPB/DTPB and C-TAM-TPB, social factors in MPCU, and imaging IDT to find it. Thompson et al. [1991] used the term social norm in defining construct and acknowledge it's similarity to subjective norms within TRA. Despite the naming the construct are called, it still contains the meaning that individual's behaviour and their influence by other important persons at work or private is a matter when it comes to acceptance of technology. How individuals think of themselves when they use EpiHandy technology is influenced by other important persons in their surroundings. Venkatesh state that the underlying constructs that is used is not significant in voluntary settings. This study is therefore not influenced by this limitation because the introduction of EpiHandy in Uganda and South-Africa is mandatory. There is also shown that the longer individuals uses the technology, the less significant the construct becomes, therefore it is only in the early stage of individual experience with EpiHandy the construct is significant [Venkatesh,

and Davis, 2000]. In this study this effect is not tested, because of the changes during fieldwork about collection of data mentioned earlier. Never the less it is important to be aware of this. Women are tended to be more sensitive to others opinions and social influence is therefore expected to be stronger for women than men [Miller, 1976, Venkatesh et al., 2000]. From the research model figure 9 page 20, social influence is influenced by age, experience of the individuals and that the technology is mandatory. It can be expected that “older” workers are more likely to place increased silence on social influences [Morris and Venkatesh, 2000] and that individuals with much experience collecting data understand the advantage of the technology better.

2.6.3 Facilitating Conditions

Venkatesh stated that Facilitating Conditions are defined as the degree to which individuals believe that organizational and technical infrastructure exists to support use of EpiHandy technology. He used three different constructors which were used to develop this unified construct: Perceived behavioural control (TPB/DTPB, C-TAM-TPB), Facilitating conditions (MPCU), and Capability (IDT). Venkatesh also stated that all this earlier constructs are similar relations and therefore there intentions are the same. Farther it is emphasised that one particular construct, perceived behavioural control is significant in both voluntary and mandatory settings immediately following training, but the influence on intention disappear by one month. There is also stated that when both performance expectancy constructs and effort expectancy constructs are present, Facilitating Conditions becomes non significant in predicting intention [Venkatesh, 2000]. As time goes, experience increase and therefore the effect of the construct also increases [Bergeron, Rivard, and De Serre, 1990]. From older workers there have been shown that they are more attached to assistance on the job using the technology [Hall and Mansfield, 1995]. However, Mahmood, Hall, and Swanberg [2001] found that organisational support was one of the most important factors when it came to using the technology.

2.6.4 Behavioural Intention

The behavioural intention is depended on Performance Expectancy, Social Influence, and indirectly depended on access to technology in childhood, and number of errors in the technology. Especially in environment like in low-income

countries, the longing and wishing for new technology is expected to be higher than normal even if there are error present. One reason might be that in low income countries people are much more used to deal with errors in daily life. Therefore it is expected to be a strong construct in this study [Sheppard, Hartwick, and Warshaw, 1988]. Taylor and Todd [1995b] define that the Behaviour Intention is the user's thoughts and anticipations about their intended behaviour using the new technology.

2.6.5 User Behaviour

The expectancy of User Behaviour while using EpiHandy technology is influenced by Behavioural Intentioned and Facilitating Conditions. The organizational and technical infrastructure has to exist using the technology to have any impact on the user. Research has mostly been done in high income countries leading to theory which might not be adequate in low income country for example Nielsen [1998] excluding the context and surroundings of the user. In ISO 9241-11, page 2, the definition of the context is defined as "*Users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used*", and that the user is the one interacting with product (hardware, software and materials).

2.6.6 Mandated Use of Technology

EpiHandy technology is intended to be mandatory for data collectors to use both in Uganda and South-Africa. They had to go through the introduction and training and accept to use this technology in one way or another. Social Influence is affected by use of mandatory technology meaning that individuals who think they do not want to use the technology or for any reasons are reluctant can influence others users negatively. Differences in the underlying relationship of the TAM and indirectly UTAUT [Brown et al., 2002] is some how present.

2.6.7 Errors in the Technology

Introduction of new technology is often followed by errors in the hardware or the software during training which again can influence the user's intention to use and acceptance of using it. The general way of introducing new technology in this case EpihandyMobile Client (software) was to have as less errors as possible, meaning that the developers had taken away almost all errors before release [Nakajo and Kuma, 1991]. Andrew and Myers [2004] stated that observing the effect of errors

found in the technology influencing the performance expectancy can be of interest.

2.6.8 Technology in childhood

To anticipate that children in Uganda and South-Africa have not had much influence of technology during childhood might not be very controversial, and that it might lead to that the willingness and "hunger" for learning new technology when they have the opportunity is higher than normal even if it contains some errors. Technology during childhood is access to telephone, car, electricity, radio, cassette recorder or CD-player [UNCTAD]. The Performance Expectancy is influenced by the access to technology during childhood and therefore it can be a parameter which influences the intention and acceptance to use Epihandy.

2.6.9 Gender, Age and Experience

In this study Gender influences the Performance Expectancy and Social Influence [Morris and Venkatesh, 2000, Minston and Schneider, 1980]. The age is a strong indication when it comes to intention and acceptance. Like Gender it influence Performance Expectancy and Social Influence, but in addition it also influence Facilitating Conditions because an older worker being for example 50 years or older need more support or at least will feel more secure using the technology knowing that there is help to get when problems accurse [Hall and Mansfield, 1995, Porter, 1963]. Experience influence Social Influence and Facilitating Conditions, meaning that people will in general regardless age and sex being more secure knowing that they have been working with collection of data many times using different questionnaires, and as a group they can also rely on each other.

3 METHOD

Methods used in this study were a mix of quantitative and qualitative data collection. Structured self filled in questionnaires was used to gather quantitative information. Observations during the qualitative study were written in notes and investigation of films taken during fieldwork was done with semi structured forms. There was also collected data by doing depth interview of selected members of the population. Table 2 below show the methods used and where they was used.

Table 2. Collection Overview and Methods used

Methods	Uganda		South Africa
	Mbale	Iganga	
Quantitative background data	X	X	X
Quantitative Intention	X	-	X
Quantitative Acceptance1	X	-	-
Quantitative Acceptance2	X	-	-
Qualitative Individual depth interview	X	-	-
Qualitative film observation	X	-	-
Qualitative notes	X	X	-

3.1 STUDY SITES

Uganda is one of the least developed countries as defined by UN with a GDP per capita of US$ 1,457 per year, the unemployment rate is currently unknown, and adult literacy rate of 68.9%. The life expectancy at birth is of 47.3 years, and mortality rate under five is 140 per 1000 [Human Development Report (HDR), 2005]. Looking at Uganda's newer history it was influenced by Great Britain until independence in 1962. From this period until 1986, political instability and civil war characterized the country. President Yoweri Kaguta Museveni, leader of the one party system, has managed to keep peace from 1986 till today except from problems with rebels in the north.

In this study data was collected at two different sites in Uganda: Mbale PROMISE EBF site and Iganga/Mayuge DSS site. They are both located in the same

geographical area. Looking at figure 10 below it is possible to get an idea of where in Uganda they are located. At each site a site coordinator was reasonable for the management from day to day and data collectors were hired for different tasks.

Uganda being a low income country rated nr 66 by the Human Development Report 2005 is located in East Africa north of Lake Victoria, with borders toward Sudan in North, Democratic Republic of Congo in west, Rwanda and Tanzania in south, and Kenya in East. The total population is 26.9 million. The infrastructure in and around these two sites were almost the same. The annual electricity consumption in Uganda is 61 Kilowatt per hours per inhabitants. The penetration of cellular phone is 30/1000 inhabitants, telephone mainlines 2/1000 inhabitants and internet users 5/1000 inhabitants [Human Development Report, 2005]. Due to frequent power cuts the sites had generators using automatic change-over in Iganga and manual change -over in Mbale. Usually it was power cut every second day lasting from 15 minutes up to one day.

Figure 10. Map of Uganda [source: UN]

Today infrastructure is poorly developed especially in the rural areas where most of the population lives (70%). Probably the most dangerous hazards for the PDA and GPS was Power cuts, transients on the power network, lack of spare parts, thefts and that the data collectors could loose them. Communication out of Uganda was quite good. Both Iganga and Mbale have good GSM (Global System for Mobile Communication) coverage and Internet service was available at public Internet café's or wireless Internet phones could be ordered from local operators like UTL [www.utl.co.ug] or MTN [www.mtn.co.ug]. These services were some how unreliable from time to time. Meaning, receiving software patches and solving software or hardware problems remote could take much time when it comes to communicate towards the developers at CIH in Norway or communicate with the other PROMISE EBF sites.

South Africa the second country this study collected data from was suppressed by apartheid regime until the freeing of Nelson Mandela in 1990 [Meredith, 2005], and it has been stabile from that time. UN defined the GDP per capita to be 10,346 US$ per year, the unemployment rate is currently estimated to be 26.2% (2004). Adult literacy rate is 82.4%, and the average life expectancy is 48.4 years. Mortality rate under five is 66 per 1000 people. The country is rated nr 56 on the human poverty index list in Human Development Report [2005]. South Africa is located south in Africa with border towards Namibia in North West, Botswana and Zimbabwe in the North, and Mozambique in the North East. South Africa is in many ways different in geography, people, economy, infrastructure, and health services from Uganda. Total population is 46.9 million people. Infrastructure index show that the annually electricity consumption in South Africa is 4,715 Kilowatt per hours per inhabitants. 364 per 1000 have cellular phone and 93 per 1000 have telephone landline. The penetration of Internet is 3.5% of the total population [Gillwald, Esselaar, Burton, and Stavrou, 2005].

The PROMISE EBF sites are situated at Paarl in the Cape region, Rietvlei, and Umlazi in Kwa Zulu Natal.

Figure 11. Map of South Africa [source: UN]

3.2 SAMPLE SIZE

The study population was recruited from the three earlier mentioned study sites, 1) Uganda PROMISE EBF, Mbale, 2) Uganda Iganga/Mayuge DSS site, and 3) South Africa PROMISE EBF, Paarl in the Cape region, Rietvlei, and Umlazi in Kwa Zulu Natal.

The number of data collectors recruited was: Mbale 7, Iganga/Mayuge 35 and South Africa 11. The total sample size was 53. All data collectors were introduced to Epihandy technology except Iganga/Mayuge site. It was only at the Mbale site the data collectors were trained substantially to use Epihandy. The data collector's job at the different sites was to travel around in the fields doing interviews and collecting the data. No one of the participating data collectors had use a PDA before this study.

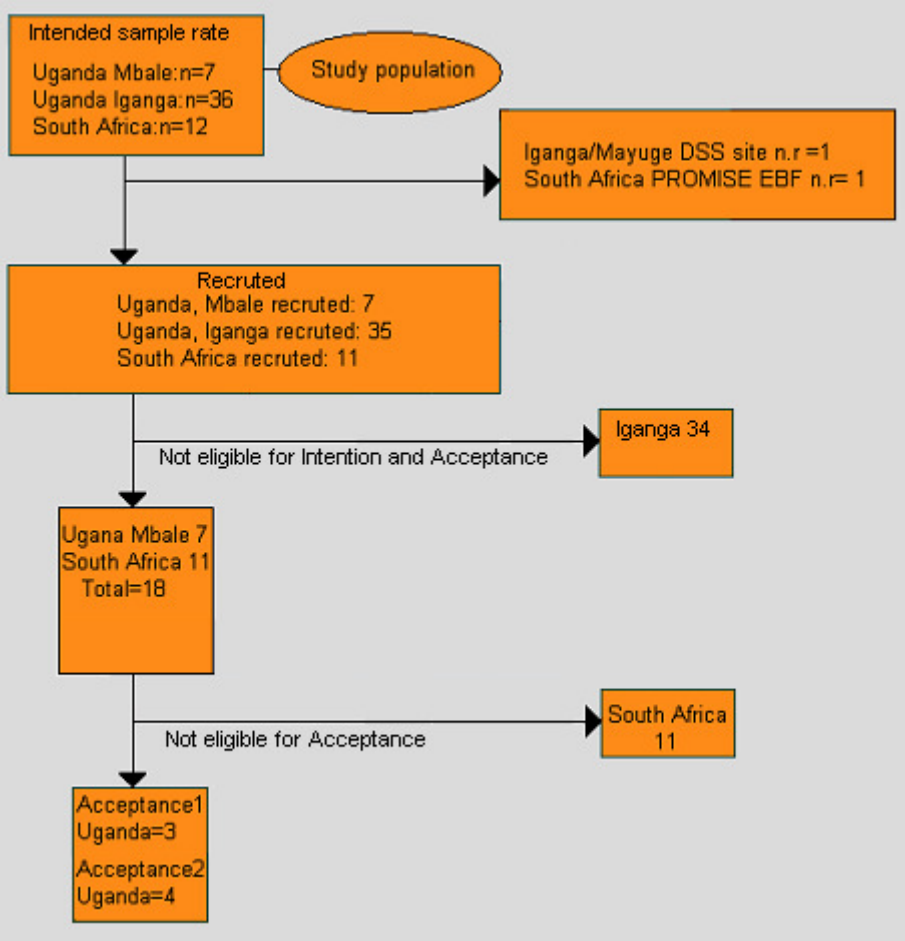


Figure 12. Data collection overview and methods used

At Iganga/Mayuge DSS site background data was collected among 35 data collectors, Mbale PROMISE EBF site 7, and in South Africa PROMISE EBF 11. In total it was collected 53 background questionnaires. In total it was collected 18 intention questionnaires in Uganda and South Africa combined, and 7 acceptance questionnaires in Mbale PROMISE EBF site. When it comes to qualitative data the following amount was collected: Filming 14 interviews done by data collectors in Mbale using PDA's, 6 using paper, in total it was 20. Five data collectors were depth interviewed and tape recorded and later transcribed. The total overview of the collected data is presented in table 3 on the next page and figure 12 above.

Table 3. Number of Collected Data and Method used

Collection method	Uganda, PROMISE EBF site Mbale	Uganda, Iganga/Mayuge DSS site	South Africa, PRMISE EBF	Total number of collected data
SES, background information	7	34	11	53
Intention	7	0	11	18
Acceptance1 and 2	8	0	0	8
Depth interview	5	0	0	5
Filming	20	0	0	20

3.3 SURVEY DESIGN

This study was mostly conducted in a working environment which was a part of the PROMISE EBF study in Mbale, working together and observing the data collectors from day to day activity, from March 15th till August 24th 2005. The collection of data at Iganga/Mayuge DSS site was done using self filled in questionnaires distributed and collected by the site coordinator. The data collection at PROMISE EBF South Africa was done using self filled in questionnaires distributed and collected by representatives from the Mbale site introducing the Epihandy technology to the data collectors in South Africa. The design of this study was based on related studies within the field of Information Systems and acceptance/intention to use technology. Quantitative and qualitative methods were performed to achieve triangulation. They are described subsequently in the following chapters.

Results from questionnaires on piloting of qualitative and quantitative acceptance and intention study is presented using the score according to Spacey et al (2004) by use of the following three constructors: *Performance Expectancy, Social Influence* and *Facilitating Conditions*. Results from observation and depth interview were analysed according to Leedy and Ormrod, and classified into the following 7 categories: *Objective, subjective*, *Attitude, Feeling, Learning, Afraid, using*. Figure 12 on page 29 show an overview where the data came from, and where it was collected.

3.3.1 Quantitative method

The quantitative method consisted of pre-tested structured self filled in questionnaires with mostly not opened ended answer options handed out to the participants [Annex A]. In general, the basic design of the background characteristics is taken from Lundberg et al. [2004], and acceptance/intention to use Venkatesh et al. [2003]. Some constructors were taken directly and some were modified to fit the study site context or new ones were added. The collection of data was done in three stages.

Firstly, SES collection was done before introduction of new technology. Information on important background characteristics and potential confounders like age, gender; social economics status, education, number of siblings, and previous exposure to technology was collected.

Secondly, collection on intention was done using a questionnaire on intention to use, using a scale divided into 5 where *1 equals completely disagree* and 5 equals *completely agree* with the following constructors: **Performance Expectancy, Social Influence and Facilitating Conditions**.

Thirdly, acceptance collection was done using a questionnaire on acceptance to use, using a scale divided into 5 where 1 equals *completely disagree* and 5 equals *completely agree* with the following constructors: **Performance Expectancy, Social Influence and Facilitating Conditions**. Since this last questionnaire was run twice during the fieldwork they were called acceptance1 and acceptance2 in order to separate them. Acceptance1 was sampled right after the data collectors were trained using the technology and acceptance2 was sampled after 6 weeks of using it. Acceptance1 and acceptance2 was compared to see if the score level of acceptance changed over time in Mbale.

All collected data were single entered into SPSS and 100% double checked for consistency. Analysis was done using SPSS12.01 where 1) Descriptive statistics was used to describe population background characteristics. Proportions' were looked at for categorical variables and means for continuous variables. 95% confidence intervals are given. 2) Mean level of constructors was investigated individually for intention and acceptance which was Performance Expectancy, Social Influence and Facilitating Conditions. The average value from 1 to 5 was given for each sub-constructor and also totalled average for the constructors was calculated.

3) Intention comparison between Uganda and South Africa was done using mean values of constructors and sub-constructors. The difference in mean value was then compared. The cut off point for recognising a difference in intention comparison was ≥ 1.5, and the scores from 1 to 5 were divided into five units. All constructors and sub-constructors are presented in table 4 on page 33 and 34.

Figure 13. Collections of Qualitative Data in the Field

Table 4. Quantitative Constructors and Sub-constructors used

Questionnaire	Constructor	Sub-constructor
Intention	Performance Expectancy	1 I am going to execute the interview more quickly using EpiHandy 2. EpiHandy will make it easier to do my job 3. EpiHandy will significantly increase quality of the output on my job 4. EpiHandy will increase the quantity of output for the same amount of effort 5.My chances of getting a next job will increase if I learn how to use EpiHandy 19. EpiHandy can be used in similar projects else were in the world 20. EpiHandy can be used in other projects not related to health 21. My job performance using EpiHandy will not differ compared to paper questionnaires I use today
	Social Influence	10. I will feel more important using EpiHandy 11. People in my project who are going to use EpiHandy have a high profile 12. The project leaders must bee helpful in the use of EpiHandy 23. If I learn to use EpiHandy, it would be embarrassing to ask for help using EpiHandy when I am supposed to be working independently
Intention	Facilitating Conditions	13. I understand how to use PDA with EpiHandy software, digital camera and GPS module 14. I have the knowledge necessary to use EpiHandy 15. I need specified instructions concerning EpiHandy software, PDA, digital camera and GPS module if I am going to use the technology 16. It would be nice to have a specific person (or group) available for assistance with system difficulties using EpiHandy 17. I think that EpiHandy fits well with the way I like to work 18. EpiHandy fits into my work style 22.If I learning to use PDA with EpiHandy software, digital camera and GPS module, it will be difficult to get help using the technology

Acceptance1 and 2	Performance Expectancy	1. I can execute the interview more quickly using EpiHandy 2. EpiHandy makes it easier to do my job 3. EpiHandy will significantly increase quality of the output on my job 4. EpiHandy will increase the quantity of output for the same amount of effort 5.My chances of getting a next job will increase by using EpiHandy 19. EpiHandy can be used in similar projects else were in the world 20. EpiHandy can be used in other projects not related to health 21. There is no difference in my job performance using EpiHandy compared to paper questionnaires
Acceptance1 and 2	Social Influence	10. I feel more important using EpiHandy 11. People in my project who use EpiHandy have a high profile 12. The project leaders have been helpful in the use of EpiHandy 23. It would be embarrassing to ask for help using EpiHandy when I am supposed to be working independently
	Facilitating Conditions	13. I have control over using PDA with EpiHandy software, digital camera and GPS module 14. I have the knowledge necessary to use EpiHandy 15. Specialized instructions concerning EpiHandy software, PDA, digital camera and GPS module was available to me 16. A specific person (or group) is available for assistance with system difficulties using EpiHandy 17. I think that using EpiHandy fits well with the way I like to work 18. Using EpiHandy fits into my work style

3.3.2 Qualitative method

The qualitative data was collected using three methods.

1) Depth interview with 5 key informants being interviewed using semi structured open ended questions [Annex J]. Average time was approximately 45 min. The Interview was tape recorded after they had used the technology for about 9 weeks. They were transcribed using Microsoft Word 2003 capturing the following: *Learning to use technology, hardest thing to learn, any difference in contact with the interviewee, biggest advantage, biggest disadvantages, the one deciding to use or not, afraid of when using, ever got upset angry or disappointed about having to use, cheapest to collect data using EpiHandy or paper questionnaires and comment about using*. The depth interviews captured individual feelings the data collectors had when they used the technology, the following was captured: *feeling of being important*, *how they communicate with the interviewee*, *attitude towards using*, *knowledge and how they look upon them selves when it comes to learn how to use new technology*. The transcribed interviews were coded and grouped into the following: *Attitude, Feeling, Learning, Afraid,* and *Using*

2) 20 film observations using paper only, PDA only or both. They were investigated by checking for objective and subjective outcomes. The objective outcomes were the following: *Gender, Time used, Spoken language used, Questionnaire language used, Technical problem with PDA/GPS,* and *Number of Interrupt because of equipment error.* These observations were supposed to uncover everything from technical problems with the equipment to the individual data collector's way of handling the situation using PDA instead of paper. During filming it was also taken notes using semi structured forms [Annex F] in order to support the analysis of films. The subjective outcomes were the following according to a scale from 1 to 5, where 1 indicated Not, and 5 indicated Is. The following was used: *Relaxed, Confident, Feeling important, Questionnaire easy to use, Participants cooperative, Contact between the Interviewer and Interviewee, and Total impression of using.*

3) Observed errors were done when any person working for PROMISE EBF in Mbale reported that they had found errors in the software (MobilClient, StudyManager, and SQL database) or hardware (PDA or GPS). The errors were summarised into the three modules: *MobileClient, StudyManager,* and *SQL*

database. They were grouped into who discovered them: *Data Collectors*, *Questionnaire Designer*, and *Computer manager*. In addition the total proportions between them were also investigated. They were also categorised or classified as the following “Low, Medium and High” in order to distinct the severity of the errors. Low was defined errors not affecting the use of the technology, like the graphical user interface. Medium was defined when functions did not work and work around had to be made in order to use the technology. The definition of High was errors influencing the use of the technology, like saving problems and synchronisation problems, meaning loss of collected data.

Figure 14. Setup during Filming of Data Collectors

3.4 ETHICAL ISSUES

This study was not designed to hold sensitive information with respect to individuals, project groups or the data they collect. All individuals participating in this study was informed orally, and consent was obtained before study-participation [Annex G]. This was done before questionnaires were distributed, interviews filmed, and depth interview was tape recorded. There was no risk involved and all data was kept confidential at all time. Anyhow, varying local practises demanded ethical clearance from Makerere University, Faculty of Technology research committee, and the Uganda National Council of Science and Technology beyond principal’s investigators expectations. That in local practice explains the majority of loss to

follow up in the Igangan DSS site, were quantitative approach was planned (Intetion, Acceptance1 and Acceptance2).

During collection in Uganda and South Africa, the fieldworkers were given unique identification numbers instead of names which was used when questionnaires were filled in, in order to hide the respondent's identity, and at the same time making it possible to link the cases and data from different questionnaires (SES and UTAUT). The field workers did not suffer any other risks except the individual stress some question might have caused. The fieldworkers are going to get feedback through their projects leaders and team leaders by receiving a written summary report explaining what they participated in and their contribution in this study, and results.

4 RESULTS

4.1 CHARACTERISTICS OF THE PARTICIPANTS

The following outcome measures were found describing characteristics of the participants. For the total sample it was investigated gender, education level, living in urban/rural area, and access to technology during childhood and youth (table 5 below). Almost all participants completed (96.2%) the questionnaire.

Table 5. Characteristics of the Participants

	Total *N*= 53
Age (in years)	mean 27,3 95%CI (22,0-32,5)
	n (%)
Gender	
Male	20 (38%)
Female	33 (62%)
Country affiliation	
Uganda	42 (79%)
South Africa	11 (21%)
Urban/Rural background now	
Rural	29 (55%)
Urban	24 (45%)
Urban/Rural background in childhood	
Rural	35 (66%)
Urban	18 (34%)
Educational level of Primary school	
P4-P7	1 (2%)
>P7	1 (2%)
S1-S4	2 (4%)
S5-S6	6 (11%)
>S6	43 (81%)
Educational level of Higher education	
No level	11 (21%)
Diploma/Certificate	27 (51%)
Collage	2 (4%)
University	13 (25%)

Parents educational level of Primary school	
Mother:	
No level	11 (21%)
P1-P3	1 (2%)
P4-P7	11 (21%)
>P7	9 (17%)
S1-S4	5 (9%)
S5-S6	2 (4%)
>S6	14 (26%)
Father:	
No level	9 (17%)
P1-P3	1 (2%)
P4-P7	8 (15%)
>P7	11 (21%)
S1-S4	4 (8%)
S5-S6	3 (6%)
>S6	17 (32%)
Parents educational level of Higher education	
Mother:	
No level	39 (74%)
Diploma/Certificate	12 (22%)
University	2 (4%)
Father:	
No level	34 (64%)
Diploma/Certificate	9 (17%)
Collage	2 (4%)
University	7 (13%)
PhD	1 (2%)
Siblings	
Siblings in number (mean)	7,40 siblings
Informants siblings number (mean)	3,86 number among siblings
Use of technology	
Own Mobile phone	35 (66%)
Own a Computer	5 (9%)
Use Internet	
Never	24 (45%)
Once a month	7 (13%)
Once a week or more	7 (13%)
Every day	8 (15%)
Missing value	7 (14%)

4.2 MEASURES AND THEIR RELATION TO BACKGROUND CHARACTERISTICS

Table 6 on the next page shows country specific results on *place of residence during childhood, access to technology in childhood,* and *use of technology now*.

In Uganda 52.4% lived in urban areas, 45.2% in rural areas. Most of the data collectors in South Africa came from urban areas, 63.6%, and 36.4 had rural background.

The background characteristics on use and access to technology in childhood (until age of 18) were like the following in Uganda: 26.2% had access to mobile phone, 19% cassette-recorder, 45.2% TV, 31% car, 52.4% electricity, 16.7% CD player, and 26,2% telephone landline. In South Africa the results was: 9.1% had access to mobile phone, 45.5% cassette-recorder, 63,6% TV, 54.5% car, 63.6% electricity, 27.3% CD player, and 63.6% telephone landline.

Country specific result on use of Internet now was the following: In Uganda, 54.8% never use Internet, 16.7% use it once a month, 9.5% once a week or more, and 2.4% every day. In South Africa, 9.1% never use Internet, 0% use it once a month, 27.3% once a week or more, and 63.6% every day.

Country specific use of technology in daily life was as following Uganda: 11.9% can use Internet explorer, 47.6% can use word, 2.4% own a computer, and 59.5% own a mobile. The following results were found in South Africa: 54.5% can use Internet explorer, 81.8% can use word, 36.4% own a computer, and 81.8% own a mobile. On the next page all data are presented in table format (table 6).

Table 6. Living in Rural or Urban Conditions during Childhood, and Use of Technology in Childhood and Today

Question	Uganda (n.r=2,4%)		South Africa	
	Urban	Rural	Urban	Rural
Main residence during childhood and youth	52,4%	45,2%	63,6%	36,4%

Question	Uganda	South Africa
Working mobile phone in childhood	26,2%	9,1%
Working cassette-recorder in childhood	19%	45,5%
Working TV in childhood	45,2%	63,6%
Working car in childhood	31%	54,5%
Working electricity in childhood	52,4%	63,6%
Working CD player in childhood	16,7%	27,3%
Working Telephone landline in childhood	26,2%	63,%

Question	Uganda (n.r=16,6%)				South Africa			
	Never	Once a month	Once a week or more	Every day	Never	Once a month	Once a week or more	Every day
Use of Internet	54,8%	16,7%	9,5%	2,4%	9,1%	0%	27,3%	63,6%

Question	Uganda	South Africa
Can use internet explorer	11,9%	54,5%
Can use word	47,6%	81,8%
Own a computer now	2,4%	36,4%
Own mobile now	59,5%	81,8%

n.r = none respondents

4.3 UGANDA, SOUTH AFRICA COMPARISON ON INTENTION

Comparison on intention was done between Uganda and South Africa. The score from 1 to 5 indicate the level of agreeing meaning 1 equals *completely disagree* and 5 equals *completely agree*. All details about each question related to the constructors *Performance Expectancy*, *Social Influence* and *Facilitating Conditions*, are all presented in table 7 page 42, and table 8 page 43.

Looking at the scores in table 7 there was no difference between South Africa and Uganda according to ≥ 1.5 units, except from sub-constructor "I will feel more important using EpiHandy. This result is presented in detail in the end of this chapter

Table 7. Result on Uganda, South Africa Comparison on Intention

Constructors	Sub-constructors	South Africa	Uganda
Performance Expectancy	1 I am going to execute the interview more quickly using EpiHandy	4.33	3.6
	2. EpiHandy will make it easier to do my job	4.11	4.0
	3. EpiHandy will significantly increase quality of the output on my job	4.11	4.0
	4. EpiHandy will increase the quantity of output for the same amount of effort	3.78	3.6
	5.My chances of getting a next job will increase if I learn how to use EpiHandy	3.33	4.4
	19. EpiHandy can be used in similar projects else were in the world	5.0	5.0
	20. EpiHandy can be used in other projects not related to health	4.89	5.0
	21. My job performance using EpiHandy will not differ compared to paper questionnaires I use today	2.44	3.8
Social Influence	10. I will feel more important using EpiHandy	3.78	2.0
	11. People in my project who are going to use EpiHandy have a high profile	3.44	3.2
	12. The project leaders must bee helpful in the use of EpiHandy	4.89	5.0
	23. If I learn to use EpiHandy, it would be embarrassing to ask for help using EpiHandy when I am supposed to be working independently	1.33	1.6

Table 8. Result on Uganda, South Africa Comparison on Iintention

Constructors	Sub-constructors	South Africa	Uganda
Facilitating Conditions	13. I understand how to use PDA with EpiHandy software, digital camera and GPS module	3.22	4.17
	14. I have the knowledge necessary to use EpiHandy	3.78	4.67
	15. I need specified instructions concerning EpiHandy software, PDA, digital camera and GPS module if I am going to use the technology	4.78	3.83
	16. It would be nice to have a specific person (or group) available for assistance with system difficulties using EpiHandy	4.67	4.0
	17. I think that EpiHandy fits well with the way I like to work	4.67	4.0
	18. EpiHandy fits into my work style	4.56	4.17
	22.If I learning to use PDA with EpiHandy software, digital camera and GPS module, it will be difficult to get help using the technology	2.44	1.17

Results on feeling important using the technology from constructor Social Influence showed a difference in 1.78 units, where South Africa scored 3.78 units, and Uganda scored 2.0. This result is presented in figure 15 on below. All other sub-constructors did not equal or exceeded the limit of 1.5 units in difference.

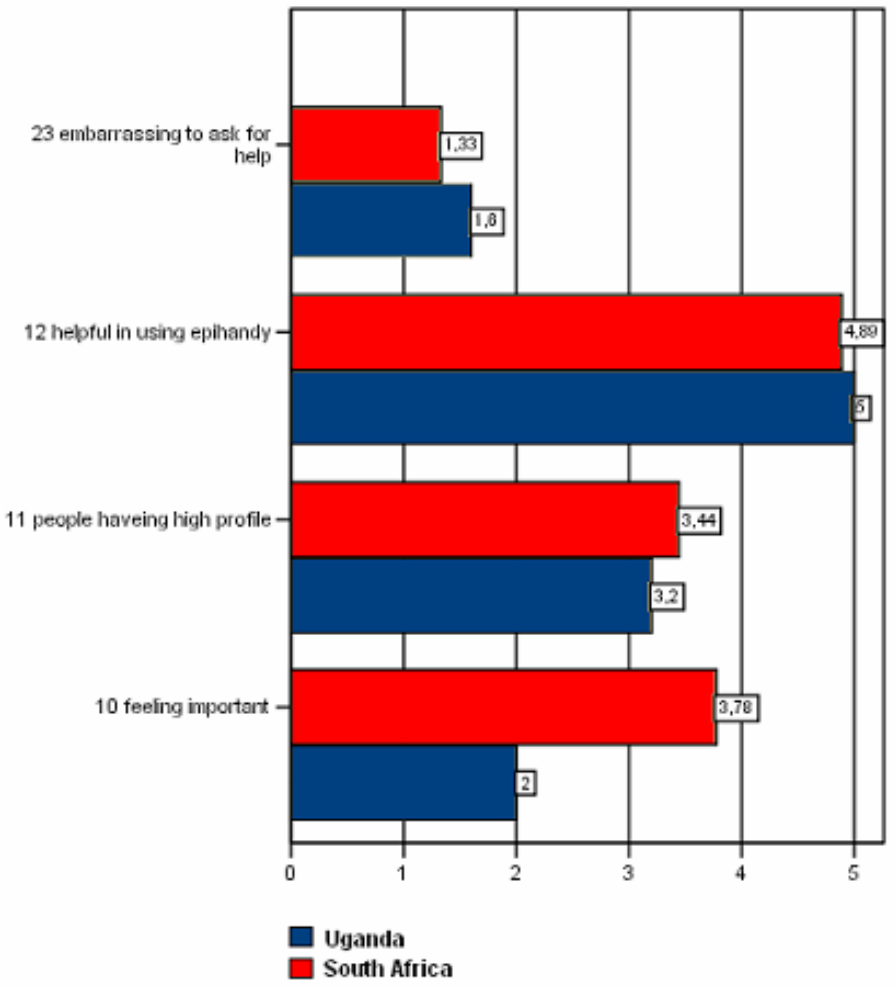


Figure 15. Comparing South Africa Uganda Intention to Use

4.4 EVALUATION OF INTENTION AND ACCEPTANCE

All referred question numbers are related to the same numbers used in the questionnaire [Annex A], and all bar plots are presented in Annex I.

4.4.1 Intention

Figure 16 in Annex I show question 1 to 5 from Venkatesh and the new questions 19 to 21 used together to determine the level of **Performance Expectancy**. The results show that many thought they would do the interview faster using PDA instead of paper (4.07). They also meant that the job would be easier to do (4.07) and that the quality would increase (4.07). The score of believing that the quantity would increase was 3.71, and 3.71 was the score showing their level of believing learning to use EpiHandy would increase the chance of getting next job. The data collectors scored 5.0 believing EpiHandy could be used in similar projects else were, and that the job performance did not differ using PDA instead of paper (2.93). Results show that Performance Expectancy on intention had an average on 4.1. The bar plot for all individual mentioned sub-constructors describing the constructor: Performance Expectancy of the Intention score are presented in Annex I.

Figure 17 in Annex I show question 10 to 12 from Venkatesh and the new question 23 used together to determine the level of **Social Influence**. The data collectors had a score of 2.0 of feeling important using PDA, and they believed that people in their project using EpiHandy is going to have a high profile scored 3.2. The score on believing that the project leaders would be helpful in using EpiHandy was 5.0, and believing that it would be embarrassing to ask for help scored 1.6. The average score of intended Social Influence was 2.95. The bar plot for all individual mentioned sub-constructors describing the constructor: Social Influence of the Intention score are presented in Annex I.

Figure 18 in Annex I show question 13 to 18 from Venkatesh and the new question 22 used together to determine the level of **Facilitating Conditions**. The statement, under stand to use EpiHandy scored 3.6, and that they had the knowledge scored 4.13. The data collectors score in need of specified instructions using EpiHandy scored 4.4. Their believe in dedicated person/group available using the technology scored 4.4. Using EpiHandy fit well the way of working scored 4.4,

and that it fit into the work stile scored 4.4. It would be difficult getting help after learning to use EpiHandy scored 1.93. The average score of intended Facilitating Conditions was 3.9. The bar plot for all individual mentioned sub-constructors describing the constructor: Facilitating Condition of the Intention score are presented in Annex I.

4.4.2 Acceptance1

Questions 1 to 5 in figure 19 Annex I are taken from Venkatesh. In addition it was necessary to add some new questions because of the local situations and surroundings; they are given from 19 to 21. All of them are used to determine the level of **Performance Expectancy**. The result on the data collector's statement, that they did the interview faster using PDA instead of paper was 5.0. They also meant that the job was easier to do (4.67) and that the quality increased (3.33). Scoring on the statement, that the quantity would increase was 4.0, and 3.67 was the score showing their level of learning to use EpiHandy would increase the chance of getting next job. The data collectors scored 5.0 meaning EpiHandy could be used in similar projects else were, and that the job performance did not differ using PDA instead of paper (2.33). Results show that Performance Expectancy on acceptance1 had an average on 4.0. The bar plot for all individual mentioned sub-constructors describing the constructor: Performance Expectancy of the Acceptance1 score are presented in Annex I.

Figure 20 in Annex I show question 10 to 12 taken from Venkatesh and a new question 23 used to determine together the level of **Social Influence**. The data collectors had a score of 2.67 of feeling important using PDA, and they stated that people in their project using EpiHandy have a high profile scoring 2.33. Score showed that the project leaders would be helpful in using EpiHandy was 4.93, and that it would be embarrassing to ask for help scored 1.43. The average score of acceptance1 Social Influence was 3.2. The bar plot for all individual mentioned sub-constructors describing the constructor: Social Influence of the Acceptance1 score are presented in Annex I.

Figure 21 in Annex I show question 13 to 18 taken from Venkatesh and a new question 22 used to determine together the level of **Facilitating Conditions**. The statement, under stand to use EpiHandy scored 5.0, and that they had the knowledge scored 5.0. The data collectors score in need of specified instructions using EpiHandy scored 4.5. In need of dedicated person/group being available using the technology scored 5.0. Using EpiHandy fit well the way of working scored 5.0 and that it fit into the work stile scored 4.5. It was difficult getting help after learning to use EpiHandy scored 1.0. The average score of acceptance1 Facilitating Conditions was 4.3. The bar plot for all individual mentioned sub-constructors describing the constructor: Facilitating Condition of the Acceptance1 score are presented in Annex I.

4.4.3 Acceptance2

Figure 22 in Annex I show Questions 1 to 5 taken from Venkatesh and the new questions 19 to 21 determine together the level of **Performance Expectancy**. The result from the data collector's statement showed, that they did the interview faster using PDA instead of paper was 4.75. They also meant that the job was easier to do (4.5) and that the quality increased (4.5). The scoring on the statement, that the quantity increased was 4.0, and 5.0 was the score showing their level of learning to use EpiHandy would increase the chance of getting next job. The data collectors scored 5.0 meaning EpiHandy could be used in similar projects else were, and that the job performance did not differ using PDA instead of paper (2.5). Results show that Performance Expectancy on acceptance2 had an average on 4.4. The bar plot for Performance Expectancy of the Acceptance2 score are presented in Annex I.

Figure 23 in Annex I show question 10 to 12 from Venkatesh and the new question 23 used together to determine the level of **Social Influence**. The data collectors had a score of 3.5 of feeling important using PDA, and they stated that people in their project using EpiHandy have a high profile scoring 3.25. The score showing that the project leaders would be helpful in using EpiHandy was 5.0, and that it would be embarrassing to ask for help scored 1.25. The average score of acceptance2 Social Influence was 3.25. The bar plot for all individual mentioned sub-constructors describing the constructor: Social Influence of the Acceptance2 score are presented in Annex I.

Figure 24 in Annex I show question 13 to 18 from Venkatesh and the new

question 22 used together to determine the level of **Facilitating Conditions**. The statement, under stand to use EpiHandy scored 4.5, and that they had the knowledge scored 5.0. The data collectors score in need of specified instructions using EpiHandy 4.75. In need of dedicated person/group being available using the technology scored 4.75. Using EpiHandy fit well the way of working scored 4.75 and that it fit into the work stile scored 4.75. It was difficult getting help after learning to use EpiHandy scored 1.0. The average score of acceptance2 Facilitating Conditions was 4.2. The bar plot for all individual mentioned sub-constructors describing the constructor: Facilitating Condition of the Acceptance2 score are presented in Annex I.

4.4.4 Comparing Intention and Acceptance in Uganda

Results from comparing intention to use and acceptance of using in Uganda are presented in table 9 below and bar plot in figure 17- 25 Annex I.

The results from comparing the sub-constructors did not show any difference being equal or exceeding ≥ 1.5 units, except from sub-constructor "*10. I will feel more important using EpiHandy*". This result is presented in detail in the end of this chapter.

Table 9. Results on Comparing Intention and Acceptance in Uganda

Constructor	Sub-constructors	Intention	Acceptance1	Acceptance2
Performance Expectancy	1 I am going to execute the interview more quickly using EpiHandy	4.07	5.0	4.75
	2. EpiHandy will make it easier to do my job	4.07	4.67	4.5
	3. EpiHandy will significantly increase quality of the output on my job	4.07	3.33	4.5
	4. EpiHandy will increase the quantity of output for the same amount of effort	3.71	4.0	4.0
	5.My chances of getting a next job will increase if I learn how to use EpiHandy	3.71	3.67	5.0
	19. EpiHandy can be used in similar projects else were in the world	5.0	4.0	5.0
	20. EpiHandy can be used in other projects not related to health	4.93	5.0	5.0
	21. My job performance using EpiHandy will not differ compared to paper questionnaires I use today	2.93	2.33	2.5
Social Influence	10. I will feel more important using EpiHandy	2.0	2.67	3.5
	11. People in my project who are going to use EpiHandy have a high profile	3.2	2.33	3.25
	12. The project leaders must bee helpful in the use of EpiHandy	5.0	5.0	5.0
	23. It would be embarrassing to ask for help using EpiHandy when I am supposed to be working independently	1.6	2.67	1.25

Constructor	Sub-constructors	Intention	Acceptance1	Acceptance2
Facilitating Conditions	13. I understand how to use PDA with EpiHandy software, digital camera and GPS module	3.6	5.0	4.5
	14. I have the knowledge necessary to use EpiHandy	4.13	5.0	5.0
	15. I need specified instructions concerning EpiHandy software, PDA, digital camera and GPS module if I am going to use the technology	4.4	4.5	4.75
	16. It would be nice to have a specific person (or group) available for assistance with system difficulties using EpiHandy	4.4	5.0	4.75
	17. I think that EpiHandy fits well with the way I like to work	4.4	5.0	4.75
	18. EpiHandy fits into my work style	4.4	4.5	4.75
	22.If I learning to use PDA with EpiHandy software, digital camera and GPS module, it will be difficult to get help using the technology	1.93	1.0	1.0

Looking at sub-constructor 10, *I will feel more important using EpiHandy* from the constructor Social Influence, had a result showing a difference according to the unit score ≥ 1.5. Intention score level was 2.0, acceptance1 score level was 2.67 but acceptance2 score was 3.5, making up a difference of 1.5 between intention and acceptance2. This difference is presented in figure 16 below.

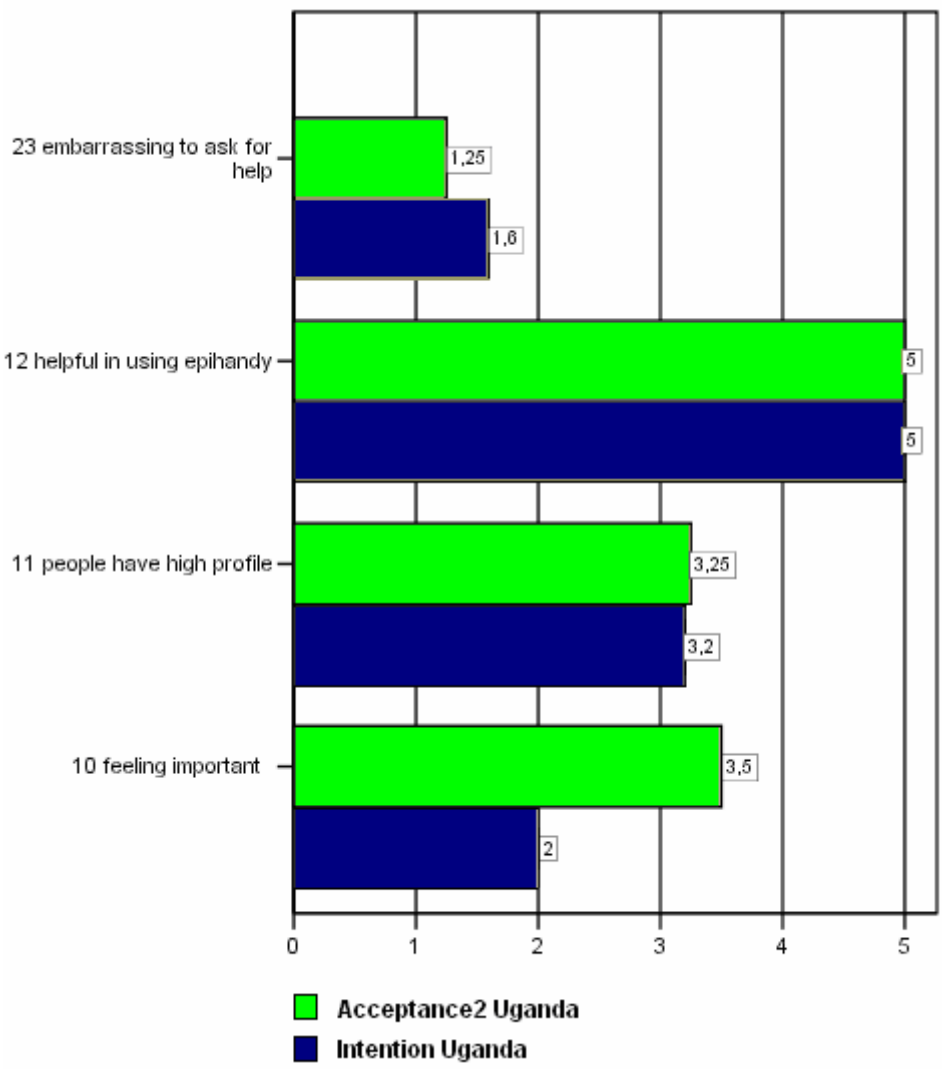


Figure 16. Comparing Intention and Acceptance2 in Uganda

4.5 EVALUATION OF DEPTH INTERVIEW, FILMING AND ERROR OBSERVATION

In this chapter all the qualitative results are presented, beginning with depth interview, then filming and lastly error observation.

4.5.1 Depth interview

Results from the depth interviews of five field workers which were transcribed, coded and classified are presented in the text below. The results from the tape recorded interviews were transcription using the interview protocol presented in Annex J.

The data collector's immediate reaction when given information about using electronic data collection was throughout positive. When they were introduced to the technology, they understood that they had to learn how to use this technology, and that it was mandatory. They also expressed that they were very happy about learning to use EpiHandy, PDA, electronic questionnaires, and GPS. Some of them had never heard about handheld computers and had no idea about what kind of technology it was. Despite limited knowledge at introduction of the technology, they showed no feelings of fear or anxiety.

They had high self-esteem when it came to learning new technology. Their confidence in own abilities to learn was high. They accepted that for the next two years this was the tool they were going to work with. They also stated that they understood that EpiHandy could be used in other research projects not related to health.

The information they gave on barriers or difficulties about learning to use the technology differed. It was no specific problem they all struggled with, but some of them said that it took some time to learn how to use the pen and the feeling on tapping, scrolling, and press and hold. Others said that the handheld computer was slow and it was difficult to distinguish between when it was working, not responding or if it was themselves that had misunderstood their tapping instructions.

During the interview, it was some who said that they knew the equipment was expensive, and they expressed concern about loosing it, dropping it on the ground and protecting it against heavy rain or thefts.

The data collectors new that during the real study they were only going to rely

on the PDA, not having paper backup in case of problems with the PDA. All data collectors were very concerned about loosing data and enter it wrongly. They said that during training they had experienced problems with the PDA loosing data during the interview, forcing them to proceed with paper backup. They had also experienced difficulties after they had finished the interviews having problems saving the questionnaires, and everybody agreed on that it would be embarrassing to ask the interviewee to do the interview once more. One of them stated that there were too many errors which caused all this problems. It was stated "*the technology is not yet developed enough to be used in a study*."

They all experienced severe difficulties using the technology, loosing data being the biggest problem. Some stated that they had been disappointed or upset when they lost data. The majority also said that if they were the one deciding to use the technology as they experienced it, they would have chosen to use paper instead. The argument for using paper instead was not only based on problems with the technology, but they thought it was cheaper to use paper questionnaires instead of electronic data collection.

All of the data collectors stated that, despite the negative experience with the technology they were all positive and enthusiastic about learning and using EpiHandy and that the technology was good. It saved time and they liked very much that the technology took care of skip and rules in the questionnaires.

4.5.2 Filming

The results from the film observation were divided into two classes, objective and subjective categorized data. The objective data are presented in table 10 and the subjective data are presented in table 11.

Gender distribution in the observations was 10 (50%) females and 10 (50%) males. The PDA failed in 71% of the cases during the interviews when it was executed by males, and 29% by females. Total average time used executing the interview using paper was on average 8 minutes, using PDA it was 14.30 minutes. Females used 8 minutes on average using paper and 16 minutes using PDA. The males used on average 14 minutes using paper and 17 minutes using PDA. Language used using paper questionnaire was 100% local (Lugisu), using PDA it changed to 86% English. The total PDA failure, men and female combined, was 50%.

By using the scale, 1 equals *NOT* and 5 equals *IS* the following results on subjective categorised data collected during filmed interviews are presented in table 11. Comparing average results using paper with the use of PDA for the subjective data no differences were found exceeding or equal to 1.5 units. Looking at gender differences using paper and using PDA the following tendencies were found. Using paper males were more *relaxed* during the interview (5.0) than using PDA (3.25). The female's level of being *relaxed* using paper was 3.2, and using PDA it was 2.7. It was no difference in Male's level of being *confident* using paper and PDA (5.0 and 4.75). The female's level of being *confident* using paper was 4.8, but using PDA it dropped to 2.7. The *feeling of being important* using paper indicated that male's level was 2.0, and using PDA it was 4.3. For the female's it was no difference of *feeling important* using paper or PDA (4.3 and 4.47). Using paper, the male's had a level of 5.0 when it came to *how easy it was to use the questionnaire*. When they used PDA it was almost the same level. The female using paper had a level of 4.8 when it came to *how easy it was to use the questionnaire.* When they used PDA, the level decreased to 2.75. Male's had a level of 5.0 looking at the *participants' being cooperative* using paper. When they used PDA the level decreased to 3.0. Female's level of *participants' being cooperative* was 3.6 using paper, and 4.0 using PDA. The level of *contact between the interviewer and the interviewee* was 5.0 for the males using paper, and 2.5 using PDA. The level of *contact between the interviewer and the interviewee* was 3.2 for the females using paper and 2.33 using PDA.

Table 10. Result from Filming, Objective Categorised Data

Objective data			
Paper questionnaires ***N*=6**	**PDA questionnaire** ***N=7***	**PDA questionnaire failed** ***N*=7**	**Total summary using PDA**
1. Gender: 83,3% Female 16,7 % Male	1. Gender: 42,9% Female 57,1% Male	1. Gender: 28,6% Female 71,4% Male	Total Gender: 50% Female 50% Male
3. Time used (min): Average Female:8.03 Average Male:13.48 Min:6.00 Max:13.48 Total Average: 8.09	3. Time used(min): Average Female:16.05 Average Male:17.22 Min:9.39 Max:25.39 Total Average:16.49	3. Time used(min): Average Female:7.29 Average Male:13.08 Min:6.49 Max:17.44 Total Average:11.42	3. Total Time used(min) using PDA: Min:6.00 Max:25.39 Total Average PDA:14.35
4. Spoken language used: English: 0% Local (Lugisu): 100%	4. Spoken language used: English: 14,3% Local (Lugisu):85,7%	4. Spoken language used: English: 0% Local (Lugisu): 100%	Spoken language used PDA: English: 7,1% Local (Lugisu): 92,9%
5. Questionnaire language used: English: 0% Local (Lugisu): 100%	5. Questionnaire language used: English: 85,7% Local (Lugisu): 14,4%	5. Questionnaire language used: English: 71,4% Local (Lugisu): 28,6%	5. Questionnaire language used on PDA: English:78,6% Local (Lugisu): 21,4%
7. Technical problem with GPS: Female: 2 Male: 0 Total: 2	7. Technical problem with GPS or PDA: Female: 1 Male:1 Total: 2	7. Technical problem with GPS or PDA: Female: 2 Male: 5 Total: 7	Total Nr of technical problems 11
14. Nr of Interrupt because of equipment error: Female:1 Male: 0 Total: 1	14. Nr of Interrupt because of equipment error: Female:1 Male:6 Total: 7	14. Nr of Interrupt because of equipment error: Female:1 Male:6 Total:7	Total Nr of Interrupt because of equipment error: 15

Table 11. Result from Filming, Subjective Categorised Data

Subjective data			
Paper questionnaires *N*=6	**PDA questionnaire *N=7***	**PDA questionnaire failed *N*=7**	**Total summary PDA**
9. Relaxed: Female:3,2 Male:5,0 Total: 4,2	9. Relaxed: Female: 2,7 Male: 3,25 Total:3,0	9. Relaxed: Female: 3,0 Male: 4,8 Total: 4,3	9. Relaxed: 3,47
10. Confident: Female: 4,8 Male: 5,0 Total: 4,8	10. Confident: Female: 2,7 Male: 4,75 Total: 3,8	10. Confident: Female: 3,5 Male: 4,0 Total: 3,75	10. Confident: 3,74
11. Feeling important: Female: 4,6 Male: 2,0 Total: 4,2	11. Feeling important: Female: 4,33 Male: 4,25 Total:4,3	11. Feeling important: Female: 4,5 Male: 3,4 Total: 3,95	11. Feeling important: 4,12
12. Questionnaire easy to use: Female: 4,8 Male: 5,0 Total: 4,8	12. Questionnaire easy to use: Female: 2,75 Male: 4,47 Total: 4,3	12. Questionnaire easy to use: Female: 3,0 Male: 4,2 Total: 3,6	12. Questionnaire easy to use: 3,6
13. Participants cooperative: Female: 3,6 Male: 5,0 Total: 3,8	13. Participants cooperative: Female: 4,0 Male: 3,0 Total: 3,5	13. Participants cooperative: Female: 2,5 Male: 4,6 Total: 3,55	13. Participants cooperative: 3,53
16. Contact between the Interviewer and Interviewee: Female: 3,2 Male:5,0 Total: 3,5	16. Contact between the Interviewer and Interviewee: Female: 2,33 Male: 2,5 Total: 2,43	16. Contact between the Interviewer and Interviewee: Female: 2,5 Male: 3,8 Total: 3,15	16. Contact between the Interviewer and Interviewee: 2,78
17. Total impression of using paper: 4,7	18. Total impression of using PDA: 4,85	18. Total impression of using PDA which failed: 2,7	18. Total Impression of using PDA: 3,78

4.5.3 Error observation

Results on technology error observed in Mbale during the implementation of EpiHandy were documented continuously [Annex H] and the summarised results are presented in the table 12 below.

The total numbers of errors observed was 36. The errors were divided into three categories, High, Medium and Low. 61% of the errors was categorised as High, 28% as Medium and 11% as Low. The errors were discovered by the following members in the project: Designer of the Questionnaire 54%, Data Collectors 37% and Computer Manager 9%. Most errors were found in the software used to design the questionnaires (StudyManager) (51%). 40% of the errors were related to the PDA and was discovered by data collectors. The remaining 9% was related to other parts of the EpiHandy technology, like the SQL database [Annex H].

Table 12. Result from Error Observation

Modules it was detected error in	**In numbers and %**	**Who detected the error in numbers and %**
MobileClient (PDA software)	14 (40%)	Data collectors: 11 (79%) Questionnaire designer: 2 (14%) Computer Manager: 1 (7%)
StudyManager (designer software)	18 (51%)	Data collectors: 2 (11%) Questionnaire designer: 14 (78%) Computer Manager: 2 (11%)
SQL database	3 (9%)	Data collectors: 0% Questionnaire designer: 3 (100%) Computer Manager: 0%

5 DISCUSSION

The structure of the discussion is kept in the same order as chapter 5 presenting the results. The discussion is divided in to five parts: *Intention, Acceptance, Observation,* and in addition *Barriers, Practical Issues* are also discussed. The amount of data collected using the quantitative was not significant as mentioned earlier, and the quantitative results are therefore looked upon as indications and discussed thereafter. The results from depth interviews are discussed more thorough in chapter 5.3, 5.4 and 5.5.

5.1 INTENTION

Introducing new technology in low-income countries face different challenges compared to what is described in the literature when it comes to introduction in high-income countries [Forster and Snow, 1995, and Santos et al., 2005].

Looking at the results and having the definition of intention in mind, "*knowing or having knowledge of technology planned to be introduced…*" the results were low for subjective norms in Social Influence compared to previous studies [Spacey et al., 2004] except for "*12 the project leaders must be helpful in the use of EpiHandy"*. The Facilitating Condition and the Performance Expectancy had in general high scores and the control questions were accordingly low in all three constructors. As mentioned it is well known that if the users are aware of super-users or dedicated persons in the organisation the intention will increase [Lu et al., 2005]. In our context this function seamed to be more distinct than in other studies not done in low-income countries. The reason might be that the level of education in the total population is generally lower, the data collectors are not extensively exposed to technology in daily life, and they have less experience learning new technology both as adults and youth.

Comparing Uganda and South Africa neither Performance Expectancy nor Facilitating Conditions exceeded or equalled 1.5 units. It might be that the context is equal and can be looked upon as the same population. It was one exception found in Social Influence "10 *feeling of being important"* was higher in South Africa than in Uganda. The reason could be that the South African population has been exposed to stronger hierarchical system and might be part of a cultural specific explanation, but it might as well be individual variation.

5.2 ACCEPTANCE

Acceptance of technology is defined as; "*technology introduced when it has proven capable of being accurate and reliable…*" Having this definition in mind, it was not found any difference in score exceeding 1.5 units between Acceptance 1 and 2 from Mbale in Uganda. This is true for Performance Expectancy, Facilitating Conditions and Social Influence. It looks like the data collectors accepted using the technology quite fast after being trained. Individual strong preferences might also determine the answers in Acceptance 2, especially for a small sample size.

The technology contained a lot of errors and some data collectors even stated that they looked upon the technology not yet finished. This is a contradictory to the definition of acceptance of technology which deals with technology being proven capable of being accurate and reliable. The data collectors stated the opposite using EpiHandy. It was unreliable, unstable and sometimes difficult to use. Despite technical limitations the data collectors had a high level of acceptance, and the users even stated that the technology was good. Why did they accept the technology? Some obvious reasons leading to the high acceptance among the data collectors could be that the technology was mandatory, that they had paper backups, got feedback on error corrections, and experienced improved quality of the technology during the introduction and training. Additionally unemployment is high in Uganda and someone could be afraid not to keep their job.

Comparing Intention and Acceptance the only difference exceeding or equal to 1.5 units was found in sub-constructor *feeling important*. Initially the data collectors thought they would not feel much different using PDA compared to paper, but later they did. This was also discovered during observation using film camera, the level of feeling important was different comparing PDA with paper. This change might be caused by the effect that the knowledge gorge increased when the data collectors used technology the interviewees did not understand. Another reason might be that initially the data collectors did not fully understand how the use of technology could change the interaction and even their own behaviour.

Comparing Intention and Acceptance, score level of sub-constructor "5 *increase the chance of getting next job"* did not reach 1.5 units in difference, but at acceptance2 it made a jump from 3.7 to 5.0. It seams like the data collectors discovered the potential of learning EpiHandy will increase their chances of getting the next job, and that they understood that this was the tool to be use in future

research projects. It was one constructor which was essential when it came to success of implementing EpiHandy: Facilitating Conditions was undoubtedly the strongest because of CIH's physical presence in Mbale. This is what Mahomood, Hall, and Swanberg [2001] stated; organisational support is one of the most important factors when it comes to using technology.

5.3 OBSERVATION

Being the main investigator as well as the observer challenged the internal validity as far as objectivity and reproducibility is concerned. Keeping the objective distance was particularly demanding during filming. Commonsense precautions were taken as personally being in the background using the zoom, only having the microphone in the interview situation. Explanation to the study participants was given by the data collectors and oral consent obtained in advance. Some data collectors expressed they were uncomfable being filmed. This was also the case for the interviewees. After one or two film observations the data collectors were more comfortable and did not complain. By using time together with the data collectors and working together as colleagues intimacy increased at the stage of depth interviews. Accordingly answers given were perceived as open and honest.

Structured notes were taken concurrently during the study and were used as background information in the construction of the interview guide. The observation might have coloured the interpretation of the results. The advantage doing this was that it increased the main investigators knowledge of the study site, the data collectors and the general challenges concerned with introduction of EpiHandy. The disadvantage was that it increased subjectivity and maybe introduced inaccuracy.

Through the depth interviews and film observation the data collector's expressed that they were a bit disappointed with the technology because of all the errors. But at the same time they maintained the positive attitude and believed that the technology will improved in time before the real study starts. They said that they believed the technology was useful in the context and that it also can be used in other studies not health related. One reason might be a cultural specific positive attitude; another reason might be caused by a general awareness of unemployment and fear of loosing the job if they did not show any loyalty or enthusiasm about using EpiHandy, and that the technology was mandatory to use. This effect was also found by Brown et al. [2002], stating that the attitude among the users can be negative, and

still have an effective information system.

5.4 BARRIERS

In many studies using handheld computers, barriers influencing the acceptance of the technology have been investigated. Lu et al. [2005] showed that research within the field of handheld computer adoption and health from 1998 till 2004 observed results about personal complains using PDA, like being afraid of damaging or loosing the PDA was present. The main investigator in this study found during analyses of depth interview that the participants stated that they had fear of breaking or loosing the handheld computer. The reason of being afraid, loosing or damaging it might be that the data collectors new they had to financially compensate a loss or damage.

Objective results during filming of the data collectors using PDA, showed a failure of 50%. Lu et al. found in their research the same results. The reason for a high failure percent using the PDA might be that the EpiHandy technology (MobileClient) was introduced to early with to many errors, or in combination if having to little experience using the PDA.

It was not only the data collectors which were introduced to new technology, but also the participants in the PROMISE EBF study. The reaction from being reluctant towards the technology by interviewees was hard to anticipate until the data collectors were observed in the fields. The results in this study showed that there was some who was reluctant or did not like that they were interviewed with technology they did not understand, this is also the same as described by Lu et al. [2005]. When people are exposed to something they do not understand it is quite natural being reluctant. The explanation might be as simple as this, but the picture is probably more complex and outside the definition of this study.

The results from observations showed that the male and female had different level of being comfortable using the PDA during interview situation. The male was much more comfortable. The general contact between the interviewee and interviewer decreased using PDA instead of paper, and it was no difference in gender. From earlier studies, it was no surprise that the male felt more comfortable using new technology than female, and when results showed that the contact between the two parts during interview decreased, this was again a confirmation shown in earlier studies. [Miller, 1976, Venkatesh et al., 2000].

5.5 PRACTICAL ISSUES

The main investigator observed that there are several ways to introduce new technology in order to streamline the process, and perhaps increase the intention and acceptance of EpiHandy as CIH hoped. It was not observed any plan for introduction, and the local project coordinators had to design an implementation tool arriving at the Mbale site. However, it seams like the lack of plan did not influence the intention an acceptance of using EpiHandy, and the reason could be that when the data collectors saw the project leaders from CIH was present helping out with the design of the documentation needed for training, and with error reports the individual data collectors concern about using EpiHandy disappeared. After all, the organisational support was present after all despite lack of introduction plan.

The technology in it self, PDA and GPS module was intuitive to understand for the data collectors. Knowing how to use pen and paper, it was not difficult using the same interface on the PDA. It seamed like the human interface is not the problem when it comes to acceptance, but the design of the software on the PDA like Lu et al. [2005] found. CIH as developer of EpiHandy have to understand, learn and implement a professional model in order to develop the technology further. From the observations made in Mbale and partly in Iganga the EpiHandy technology was in general introduced to early, leading to too many errors. The technology problems experienced might be the reason that the Iganga site had to postpone the introduction of EpiHandy, or that they were collecting data using paper to slow.

The process of finding errors in the technology seamed to be the main activity in Mbale and Iganga, not the introduction of the technology and teaching data collectors to accept and use the technology.

Results from data collector's background information showed that use of Internet every day differed between Uganda and South Africa. 2.4% of the data collectors in Uganda used Internet every day, and 63.3% of the data collector in South Africa used Internet every day. The most obvious reason can be that the infrastructure development in South Africa is higher than in Uganda, leading to a higher penetration of Internet use on individual basis. Having in mind that the data collectors in South Africa have adopted the use of Internet mush more than the data collectors in Uganda, the introduction of EpiHandy in South Africa might have a higher level of acceptance and intention to use, and that it will become a success story.

6 CONCLUSION

This study has uncovered more than only the intention to use and acceptance of using EpiHandy. Some results indicate that the design of this study might have been done differently if the knowledge about the observed context, and more information about earlier studies had been available, it could have lead to more information about what influenced the user when it came to using EpiHandy. Results from this study also gave answers to the stated hypotheses. Some got strengthened other was weakened.

The null hypothesis (H0), *number of errors in the technology* was strengthened. The results showed that even if it was errors present in the technology, the data collectors maintained a positive attitude all the way. The reasons influencing this might be that the technology was mandatory in use, that they new that they had to learn and accept it any way and they are used to overcome faults and errors more often in daily life using technology. H1 was falsified.

The study showed that all three constructors were present, *Performance Expectancy, Social Influence* and *Facilitating Conditions,* making H2 stronger.

It was difficult to see a link between the *background information* and the *intention and acceptance* which H3 stated. One reason could be that the study population was too small. It could be interesting extending this research which might give an answer to this.

H4 stated that the *use of English questionnaires during the study would increase.* H4 was definitely strengthen because the result showed that using PDA instead of paper made the data collectors choose English questionnaires instead of local language even when the spoken language was local. There is no direct explanation doing this, but it might be of personal choosing or limitations in the technology, because starting an interview using PDA forced the user to either choose English or local language and the default language was English.

Literature comparing paper and PDA indicate that using PDA instead of paper will *decrease the time* spend doing the interview. This study showed the opposite, meaning that H5 was falsified. The reason for this might be that the data collectors had to explain to the interviewee what kind of technology they used, and that some data collectors was a bit uncertain using the electronically questionnaire and PDA.

The intention to use and acceptance of using EpiHandy technology was high

among the data collectors even when observation uncovered a lot of errors in the technology. 50% of the interviews done using PDA failed, and organisational implementation planes were almost absent. In the end, the introduction of Epihandy in Mable went well, probably because of presence from CIH.

The level of feeling important using PDA was higher than using paper and comparing Uganda and South Africa the same result was discovered. The time spent during interview using PDA instead of paper did not decrease, in fact it increased. The male was more comfortable using PDA than female, but both male and female decreased the contact with the interviewee. The female's was faster than the male's doing interviews both using paper and PDA.

The final conclusion is that the EpiHandy technology (MobileClient software) and GPS was very mush accepted in Uganda, and there was indication that it also will be well accepted in South Africa, and probably at the other PROMISE EBF sites as well. One important factor contributing to the success implementing EpiHandy was the presence of people knowing the technology and working as super-users at the site. The constructor Facilitating Conditions was undoubtedly the strongest and was the key to the successful introduction. All data collectors in Mbale were always enthusiastic about learning and using the technology. Unfortunately much time went by looking for errors in EpiHandy at the Mbale site, and the introduction of the technology and teaching data collectors to accept and use the technology became second priority. Acceptance of Information Technology by Health Related Projects in Low-income Countries was high despite lack of introduction plan, and many errors in the technology.

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LIST OF ANNEX

Annex A Questionnaires

The following questionnaire was used during data collection of background characteristics of the population:

ID_number	_____
Information about your general background	
1 How old are you?	_____Years old
2 Are you a male or a female?	Male□ Female□
3 Which level of schooling have you completed?	Level of schooling:_____
4 Do you have higher education? (University or Collage)	Yes □ No □ (If No jump to question 7)
5 How many years did you spend at the University or Collage and what is your degree	_____Years Degree:_____
6 Name of education place; University, Faculty or Collage you attended	Name of University/ Faculty or Collage:_____
7 Where was your main residence and place/district during childhood and youth (where you spent most years)?	Rural□ Urban□ Name of place/district:_____
8 Where is your main place of residence now?	Rural□ Urban□ Name of place/district:_____
Information about your Family	
9 Which level of schooling have (had) your mother completed?	Level of schooling:_____
10. Does your mother have (had) higher education (University or Collage)?	Yes □ No □ (if No jump to question 12)
11 Which level of higher education does your mother have (had), degree?	Degree:_____
12 Which level of schooling have (had) your father completed?	Level of schooling:_____
13 Does your father have (had) higher education (University or Collage)?	Yes □ No □ (if No jump to question 15)

14 Which level of higher education does your father have (had), degree?	Degree:_____
15 How many siblings do you have?	_____Siblings
16 Among the siblings, which number are you?	_____

Information about your income generating activities	
17 During the last 12 month, for how many have you been employed? (given in month)	_____Month
17 What was your approximately income (Ush) for the last 12 month?	_____Ush

18 a, b In the household where you spent most time during childhood and youth (up to age 18), did you have any of the following items in working condition?

Borehole water□
Outdoor tap water□
Indoor tap water□
Cycle□
Scooter□
Car□
Gas□
Electricity□
Hotplate□
Cooler□
Freezer□
Television□
Radio□
Cassette-player□
Cassette-recorder□
CD-player□
Land telephone□
Mobile telephone□

Fax□ Copy machine□ Printer□ Computer□ Modem□ Internet□ None of the above□:	Specify:_____
Information about your introduction to mobile telephone and use	
19 Do you own a mobile telephone now?	Yes □ No □ (If No, please answer also question 20,21 and 22 if you have own a mobile)
20 How old were you when you got your first mobile telephone?	_____Years Do not remember □
21 Which year did you get your first mobile telephone?	_____ Do not remember □
22 What was your main reason for getting your first mobile telephone?	_____
Information about yore computer knowledge and use of computer	
23 Do you own a computer now?	Yes □ No □ (If No, please answer also question 24, 25 and 26)
24 How old were you when you used a computer for the first time?	_____Years Do not remember □
25 Where did you learn the level of computer skills you have now?	In school □ In higher education □ Internet café □ Private Computer school □ None of the mentioned, specify:_____
26 How often do you use a computer now?	Never □ Once a month □ Once a week or more □ Every day □
27 Information about your use of main applications on a computer. Write down all main applications you can use (list up)	

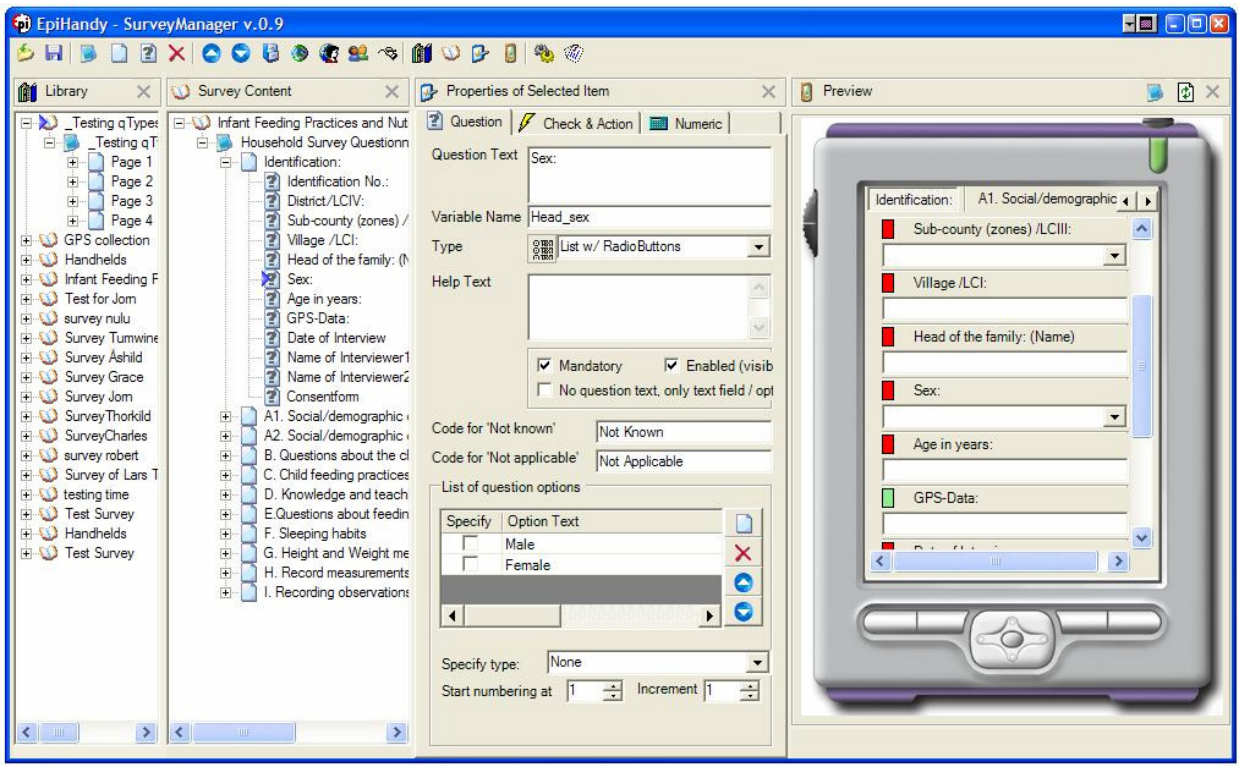
Information about your use of mediums	
28 How many books/magazines have you red last month?	_____last month
29 How often do you read news papers?	Daily □ 1-2 weekly □ 3-4 weekly □
30 How many different news papers do you read during a week?	_____
31 How often do you use Internet?	Never □ Once a month □ Once a week or more □ Every day □
32 What is your main reason for using Internet?	_____

The following questionnaire was used during UTAUT Intention and acceptance 1 and 2 data collection:

Note: By EpiHandy means handheld computer (PDA), software, digital camera and GPS module; Electronic collection					
ID number_____					
	1(completely disagree)	**2**	**3**	**4**	**5(completely agree)**
1. I can execute the interview more quickly using EpiHandy					
2. EpiHandy makes it easier to do my job					
3. EpiHandy will significantly increase quality of the output on my job					
4. EpiHandy will increase the quantity of output for the same amount of effort					
5.My chances of getting a next job will increase by using EpiHandy					
	1(completely disagree)				**5(completely agree)**
6. It is easy for me to become skilful at using EpiHandy					
7. Working with EpiHabdy is so complicated, it is difficult to understand what is going on					
8. My work actions with EpiHandy is clear and understandable					
9. It is easy for me to use EpiHandy					
	1(completely disagree)				**5(completely agree)**
10. I feel more important using EpiHandy					
11. People in my project who use EpiHandy have a high profile					
12. The project leaders have been helpful in the use of EpiHandy					
	1(completely disagree)	**2**	**3**	**4**	**5(completely agree)**

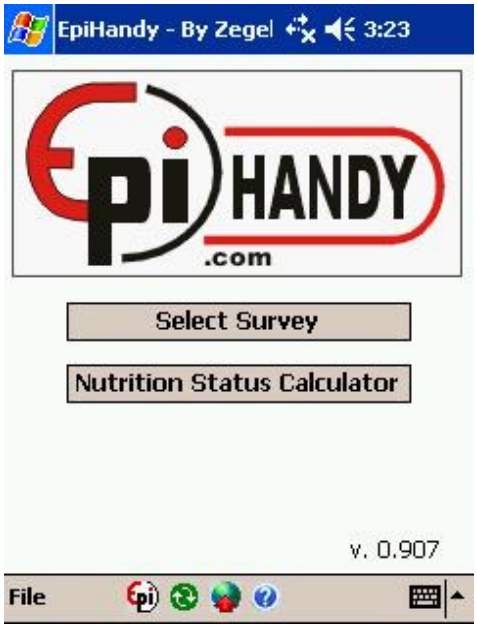
13. I have control over using PDA with EpiHandy software, digital camera and GPS module					
14. I have the knowledge necessary to use EpiHandy					
15. Specialized instructions concerning EpiHandy software, PDA, digital camera and GPS module was available to me					
16. A specific person (or group) is available for assistance with system difficulties using EpiHandy					
17. I think that using EpiHandy fits well with the way I like to work					
18. Using EpiHandy fits into my work style					
	1(completely disagree)				**5(completely agree)**
19. EpiHandy can be used in similar projects else were in the world					
20. EpiHandy can be used in other projects not related to health					
21. There is no difference in my job performance using EpiHandy compared to paper questionnaires					
22. After learning to use PDA with EpiHandy software, digital camera and GPS module, I find it difficult to get help using the technology					
23. It would be embarrassing to ask for help using EpiHandy when I am supposed to be working independently					

Annex B EpiHandy StudyManager

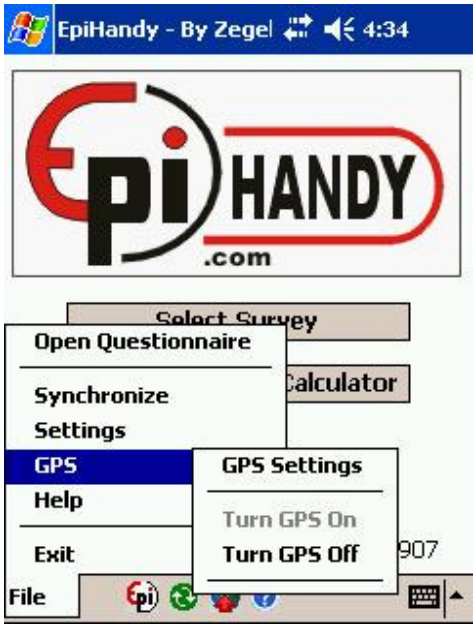


Annex C Mobile Client view

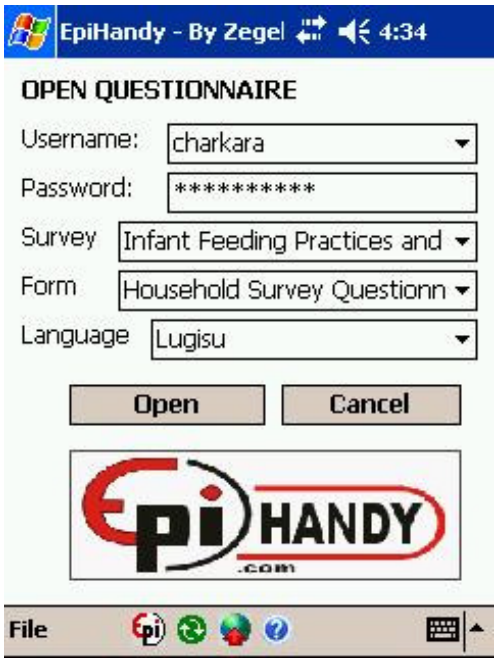
Main Menu - This is your starting point



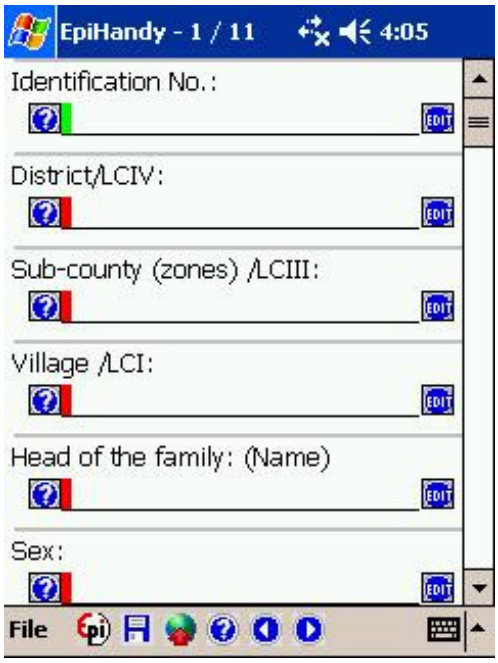
Main Menu – File menu is shown here



Select and open a survey in the selected language. The user has to supply a valid username and password to continue

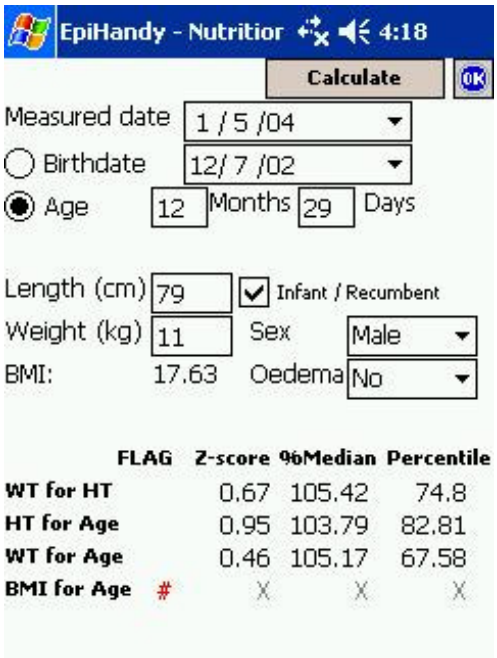


Display of a sample questionnaire

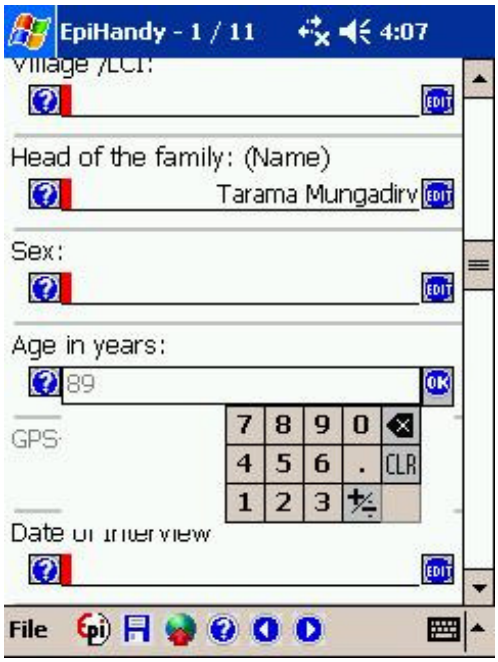


Display of text entry

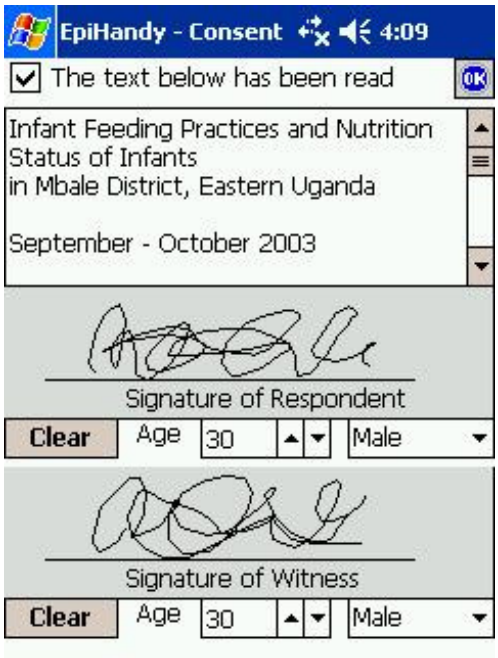
The Nutrition Status Calculator Module allows for calculation of nutritional indicators



Display of numeric entry



The Informed Consent Module allows for display of consent text and a checkbox to be ticked off before allowing signature of respondent and witness to be written

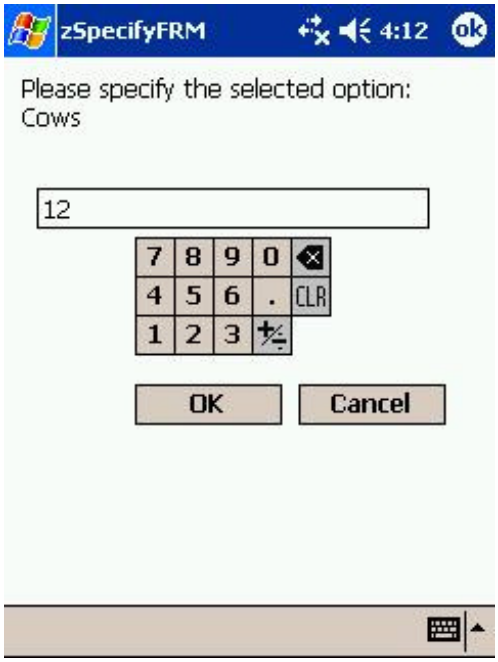


This is how a date is selected

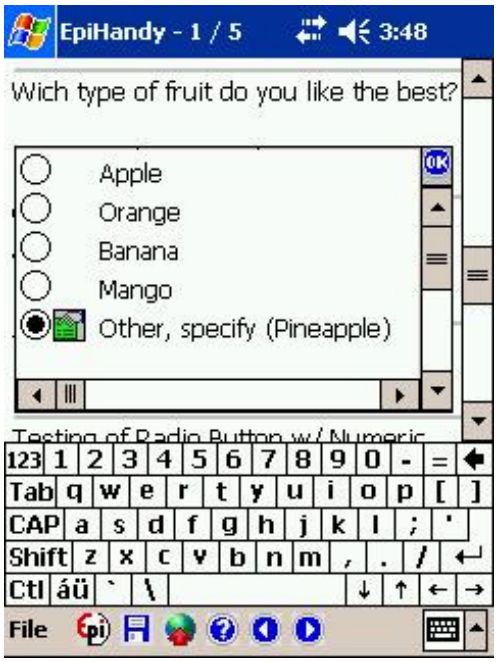
Respondents or Interviewers can sign directly on the screen

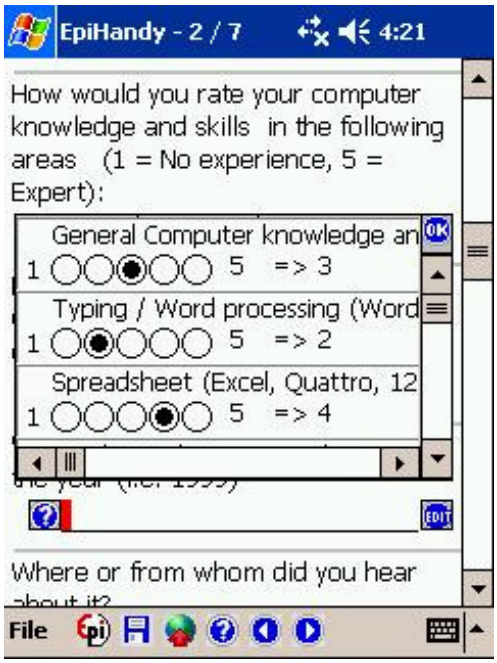
List with possibility of checking several items and specifying some extra information (List w/Checkboxes and Specify Numeric)

This is how an item in a list can be specified with a number

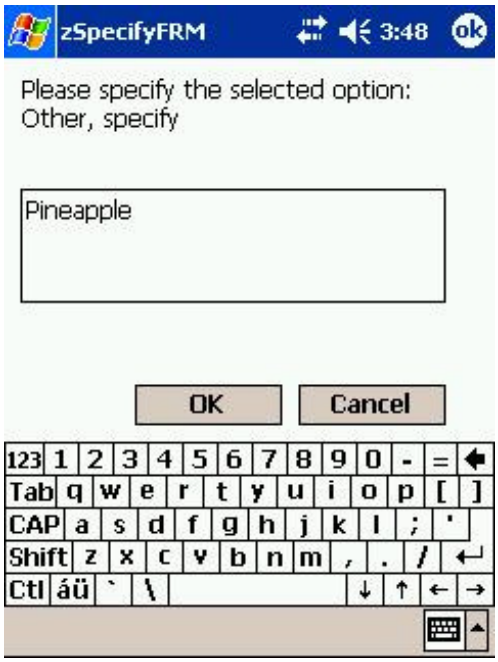


List with only one choice and specify some extra information (List w/Radio button and Specify)

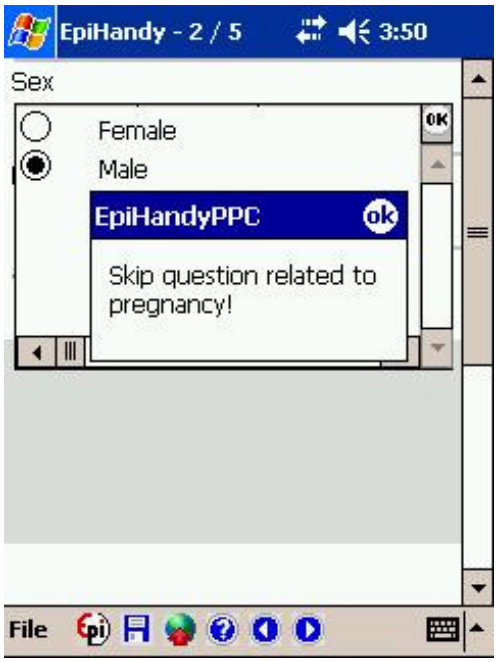




This is how an item in a list can be specified with a text



Branching demo - Picture 1/3



Branching demo - Picture 2/3

Annex D Type of questions and their functions in the MobileClient

- **Calculated Field;** letting the fieldworker use the calculator on the PDA in order to calculate numbers during the interview
- **Consent form;** letting the fieldworker ask the interviewee if he or she consent for interview
- **Date;** give the function of choosing a date in the questionnaire
- **Digits;** the function makes it possible to enter digits according to rules
- **Image Capture;** function which let the fieldworker take digital photo
- **Label** / **Title;** function which give the designer of the questionnaire possibility to give written instructions to the field worker
- **Large Text Field;** this function is similar to a small and simple word editor
- **List with Check Boxes;** one or more item can be ticked off on a list according the answer
- **List with Radio Buttons;** only one item can be ticked off on a list according the answer
- **List with Rating of Items;** different rating of items in a list can be chosen
- **List with Text Box;** items can be chosen from a list and text can be added in addition
- **List with Yes & No Buttons;** for each item in the list, there must be ticked off either yes or no
- **List with Table input;** the items in a list can be presented in a table where text can be added
- **List box (no specify);** items can be chosen from a list
- **No Type;** plain text information to the user of Epihandy Mobile Client can be given
- **Numeric;** this function gives the opportunity to only write numbers as answer
- **Nutrition Module;** a persons different anthropometrical figures can be fed in to the calculator and a health status can be given on this person
- **Signature Capture;** a function which capture the unique signature of a person, can be used for identification

- **Sub Form;** a function which can activate another questionnaire on the PDA according to the answer
- **Text;** a function similar to large text file but it holds smaller amount of text
- **Time;** function which capture the time

Annex E Hardware introduced and used by data collectors

MobileClient, PDA and SD-Card

MobileClient, PDA and GPS units (www.epihandy.com)

Front view of the PDA

Rrare view of the PDA with battery lid

Rear view of the GPS with batteries

Front view of the GPS

Annex F Pre-decided Determinants, Observations

Case study protocol, Observation study Mbale			
Determinants	ID Number _____	PDA Q	Paper Q
Time used for conducting the Recruitment interview			
Time used for conducting the Two week Recall			
Time used for conducting the Three week interview			
Time used for conducting the Six week interview			
Language used during interview (English=E, Local=L)			
Silent for longer than 1 minute			
Technical problems with the questionnaire			
Number of times voice have been increased			
Field worker relaxed during interview? (1 to 5, where 1=not and 5=very			
The field worker looks more confident. (1 to 5, where 1=not and 5=very			
The field worker level of feeling important. (1 to 5, where 1=not and 5=very			
Problems with GPS unit			

Easy to use for the field worker, (1 to 5, where 1=not and 5=very			
Hard to use for the field worker. (1 to 5, where 1=not and 5=very			
How cooperative seems the participant to be? (1 to 5, where 1=not and 5=very			
How often is the interview interrupted?			

Annex G Consent form

The following Consent form was used in the study:

Confidentiality:

The following oral information will be given: *"The information that you give shall be confidential. It will not be able to identify any persons participating in any publication or presentation about this study."*

Problems or questions:

"If you have any questions about this study, you are free to contact the following at any time; Dr Nulu Semiyaga on 04536419 coordinator for Mbale site and Edward Galiwango coordinator for Iganga/Mayuge DSS site. If you have any questions on your rights as a research volunteer you may also contact Professor E. Katabira on 041-530020."

Subjects consent:

"It has now been given an oral description to you what is going to be done, the risks, hazards and benefits involved. You must understand that your decision to participate in this study or not to do so will not affect your integrity. In the use of the information generated from this study such as publications, your identity will remain anonymous. You must be aware that you may withdraw from this study at any time."

"Farther information on research subjects' rights is available from the National Council of Science and Technology (Tel: 014- 250499 or 250431). You must understand that by participate in this study, you do not waive your legal rights nor does it relieve investigators of liability but merely indicates that you have been informed about the research study in which you are voluntarily agreeing to participate in."

Annex H Observed errors

Observed software errors during implementation of Epihandy in Mbale from 10th March-24th August 2005

Type of error and description of it	When it was detected for the first time	Level of severity (Low, Medium , High)	When it was fixed	Who detected the error
1.Export of design questionnaire from **Study Manager** for print out worked once first time	22.03 2005	High	13.07.2005	Discovered by designer of questionnaire
2. During login in **Study Manager**, using the enter button instead of mouse does not work	22.03 2005	Low	13.07.2005	Discovered by designer of questionnaire
3. Using **Study Manager**; Page numbers on a new questionnaire added under the survey does not start on one.	22.03 2005	Medium	?	Discovered by designer of questionnaire
4. Using **Study Manager** the function delete item, the text on the button in the window popping up contains is written both in English and Norwegian text.	22.03 2005	Medium	?	Discovered by designer of questionnaire
5. Creation of a new survey in **Study Manager** does not show up in the Library window until is has been saved. You have to close the study manager application and open it again before is appears	22.03 2005	Medium	13.07.2005	Discovered by designer of questionnaire
6. Using the wizard in **Study Manager** creating rules and skip instructions does not work. Event/Action Handling created the following error message: “An unhandled expectation has occurred in your application. If you click continue, the application will ignore this error and attempt to continue. If you click quit, the application will be shut down immediately. Assetta.ColumStyle.ComboBox Column requires the Data Source property to be set to valid data source”	22.03 2005	High	13.07.2005	Discovered by designer of questionnaire

7. Deleting function in **Study Manager** using Check and Action (making rules and skip) window does not work, but by clicking on delete button in the main menu the rules and skip instructions is deleted in Event/Action Handling list. In order to delete the rule and skip instruction, the hole questionnaire must be deleted	22.03 2005	High	13.07.2005	Discovered by designer of questionnaire
8. Every time the questionnaire is saved in **Study Manager** it appears a acknowledge window. This can be irritating to confirm many times during the design of the questionnaire.	22.03 2005	Low	?	Discovered by designer of questionnaire
9. Using Export function in **Study Manager**, the preview works only once, and the file is empty when you try to export it several times.	22.03 2005	High	13.07.2005	Discovered by designer of questionnaire
10. The storage function in **Study Manager** is not reliable. The last changes made in the questionnaire are not saved. It seams like you have to close the whole application in order to be chore that it is saved properly.	22.03 2005	High	?	Discovered by designer of questionnaire
11. A question type in **Mobile Client**; using the PDA the function Listbox with yes/no in MobilClient does not work.	22.03 2005	High	13.07.2005	Discovered by fieldworker
12. The power extension for charging the PDA does not fit the PDA-charger	06.05 2005	Medium	?	Discovered by site coordinator
13. After upgrading in July the **Mobile Client** software, there is error storing the collected questionnaire. Missing unique code for questionnaires. Showing only 0000000000000	20.05 2005	High	13.07.2005	Discovered by fieldworker
14. Takes to long time to open the questionnaire in **Mobile Client**, more than 10min.	29.05 2005	Medium	13.07.2005	Discovered by fieldworker
15. The function list-box with yes/no radio-buttons, does not work in **Mobile Client**. All information concerning no is deleted when the question is reopened.	29.05 2005	High	13.07.2005	Discovered by fieldworker

16. Function and type of question called Label/title does not work in **Mobile Client**	31.05 2005	Medium	?	Discovered by fieldworker
17. When designing questionnaires in **Study Manager**, the different questions can bee fixed values for coding the answer. The Default value for the question does not work	31.05 2005	Medium	01.06 2005	Discovered by fieldworker
18. The title for each page does not show on top of the **Mobile Client** screen on the PDA, only page numbers	31.05 2005	Medium	13.07.2005	Discovered by fieldworker
19. List-box with radio-buttons in **Mobile Client** containing more than seven objects does not work. They does not appear in the list at all	31.05 2005	High	13.07.2005	Discovered by fieldworker
20. Date function does not work in **Mobile Client**, the function only gives the date of the present day	31.05 2005	High	13.07.2005	Discovered by fieldworker
21. In general, the automatic adjustment of the scrolling of windows in **Mobile Client** on the PDA does not work properly. Some text does not show, and the horizontal scrolling does not show.	31.05 2005	High	13.07.2005	Discovered by fieldworker
22. In general, the automatic adjustment of the scrolling of windows in **Mobile Client** on the PDA does not work properly. Some text does not show, and the vertical scrolling does not show.	31.05 2005	High	13.07.2005	Discovered by fieldworker
23. Importing questionnaires to **Study Manager** and exporting questionnaires does not work. Almost all questions are gone	13.07.2005	High	13.07.2005	Discovered by designer of questionnaire
24. When exporting the questionnaire from **Study Manager**, it is only the English version of the questionnaire which is exported, not any other language	13.07.2005	High	17.08.2005	Discovered by designer of questionnaire

25. On the first page after opening the questionnaire on the PDA using **Mobile Client**: is to select Interviewer and closing it, the lower part of the window disappears together with the navigation buttons. Opening a new window and closing it make it come back.	13.07.2005	Medium	?	Discovered by fieldworker
26. Replication in the **SQL database** error during synchronising and the setting of the storage was changes to SD-memory card and not internal memory on the PDA	15.07.2005	High	15.07.2005	Discovered by designer of questionnaire
27. The **SQL database** stopped working, it is impossible to log on.	20.07.2005	High	10.08.2005	Discovered by designer of questionnaire
28. Replication error during synchronisation between PDA and **SQL database**.	10.08 2005	High	050810	It was the designer of the questionnaire working with study manager, super user
29. List with check box does not show all text in **Mobile Client**. The table containing the text is to short	08.08 2005	High	?	Discovered by designer of questionnaire
30. In **Study Manager** using translating wizard, clicking the store button makes the hole wizard close	11.08 2005	Low	?	Discovered by designer of questionnaire
31. Automatically collect the GPS data from the GPS module does not work in **Mobile Client**	07.07.2005	Low	050831	Discovered by designer of questionnaires
32. After upgrading the **Study Manager** and synchronising with the PDA, the three first pages are blank. When you step 3 pages forward, then the first page show up	19.08.2005	High	22.08.2005	Discovered by the one in charge over the computers in Mbale
33. After last upgrade of **Study Manager** it is possible to export local language in addition to English. But using the PDA there are some question in local language that have English text explaining the different answers	050823	High	?	Discovered by fieldworker

34. After collecting data with PDA, Synchronizing with **Study Manager,** exporting the collected data to .xml file does not work. The data from Yes, No and specify is not there	050831	High	?	Discovered by designer of questionnaires
35. Automatically collect the GPS data from the GPS module does work in **Mobile Client,** but the data for altitude is not stored. It only show cero	050831	Medium	?	Discovered by the one in charge over the computers in Mbale
36. Export function from **Study Manger**, does not work in general. There are some unwanted information present	050831	High	?	Discovered by the one in charge over the computers in Mbale

Annex I Bar plot Results from Evaluation of Intention and Acceptance

Intention

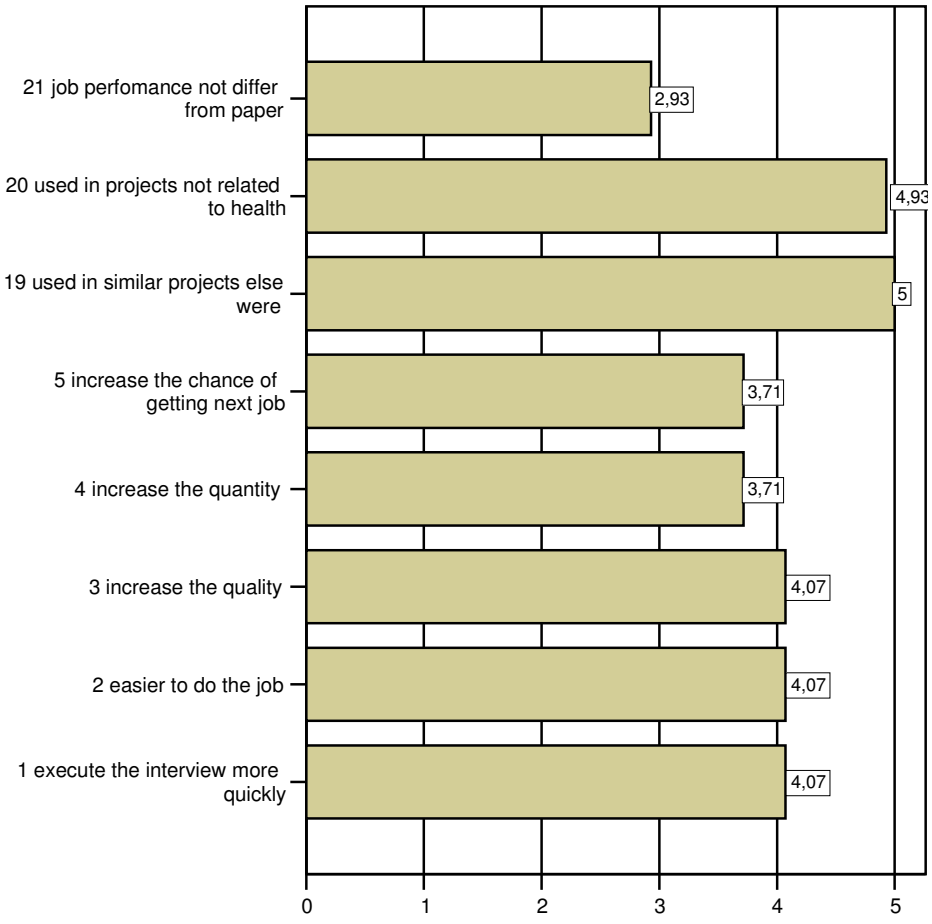


Figure 17. Performance Expectancy of the Intention score

Intention

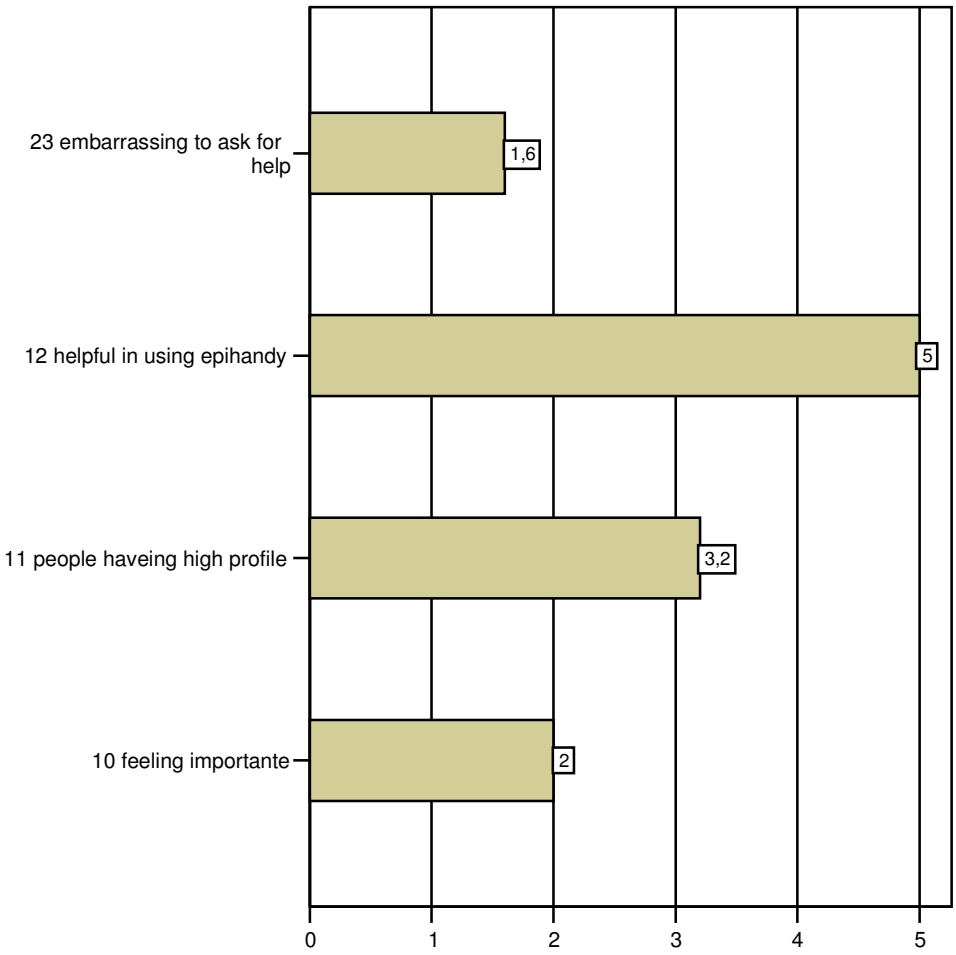


Figure 18. Social Influence of the Intention score

Intention

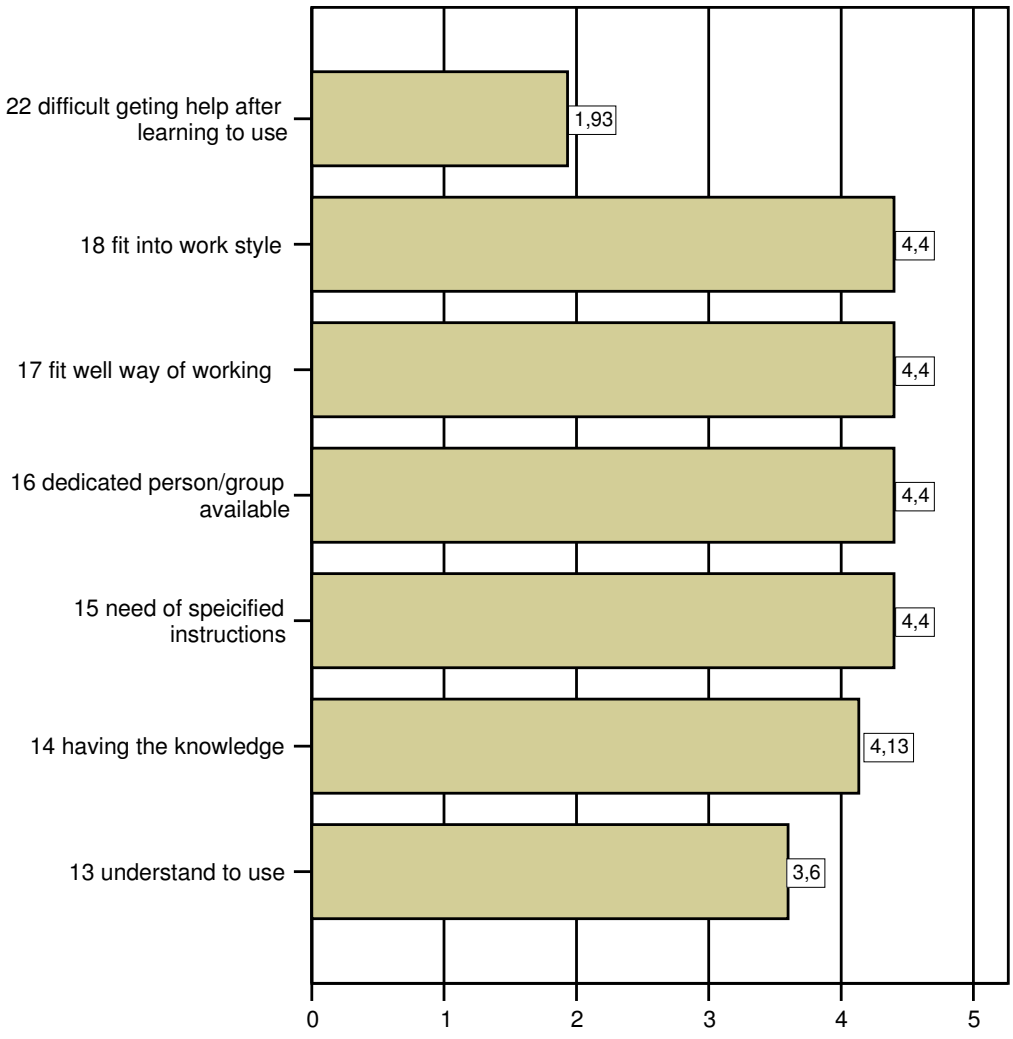


Figure 19. Facilitating Condition of the Intention score

Acceptance1

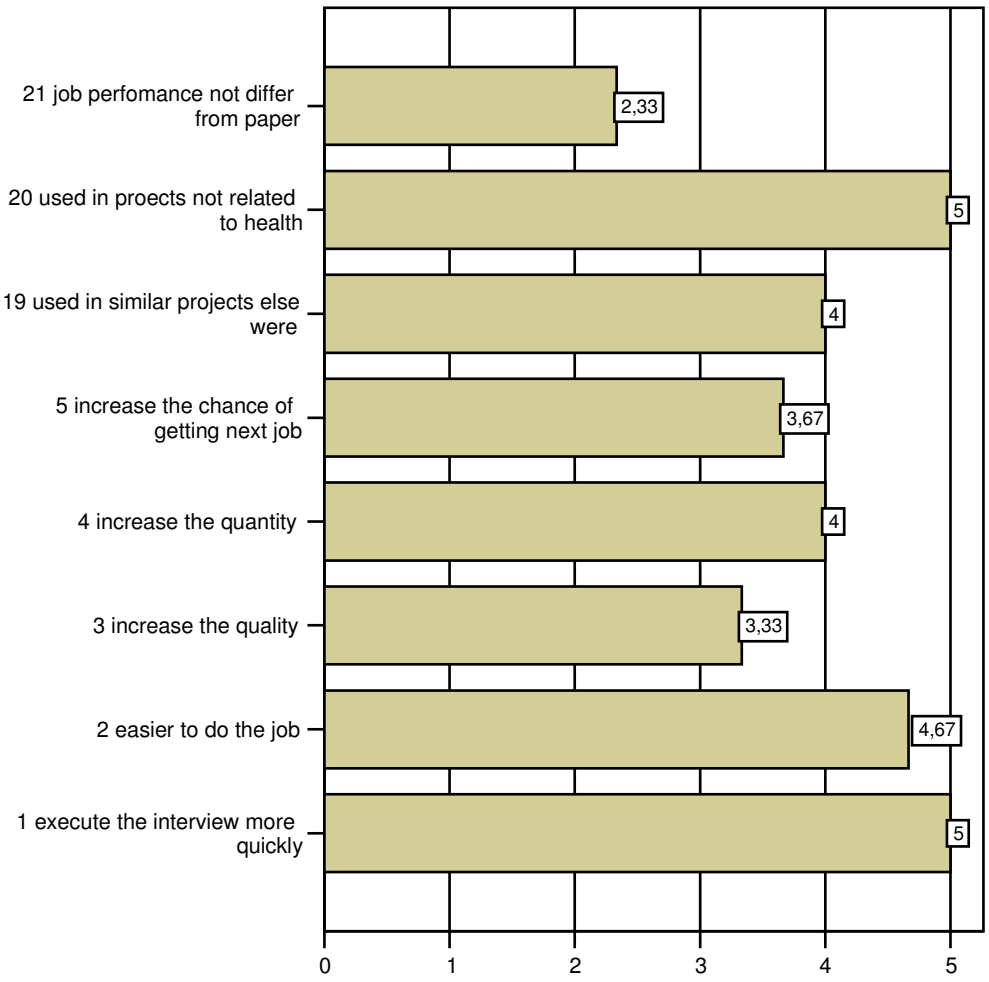


Figure 20. Performance Expectancy of the Acceptance1 score

Acceptance1

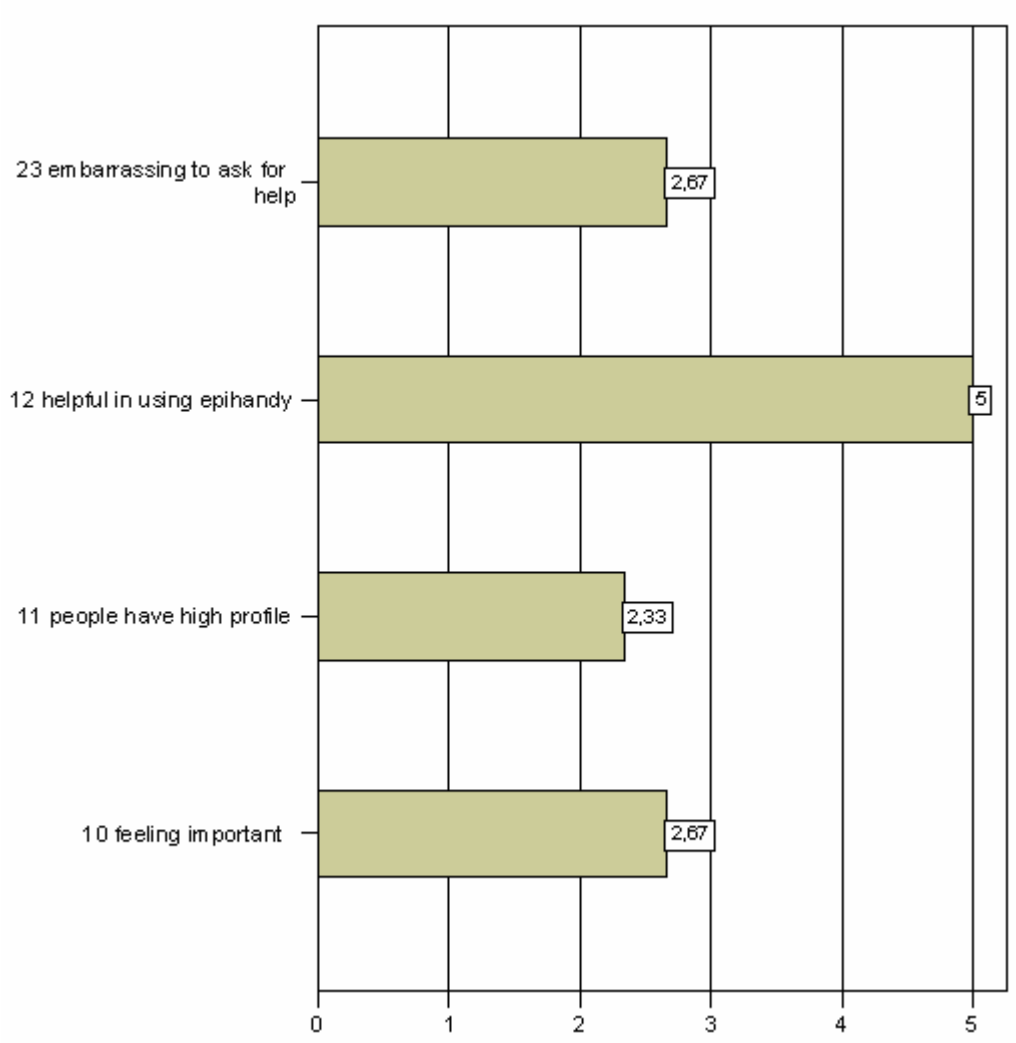


Figure 21. Social Influence of the Acceptance1 score

Acceptance1

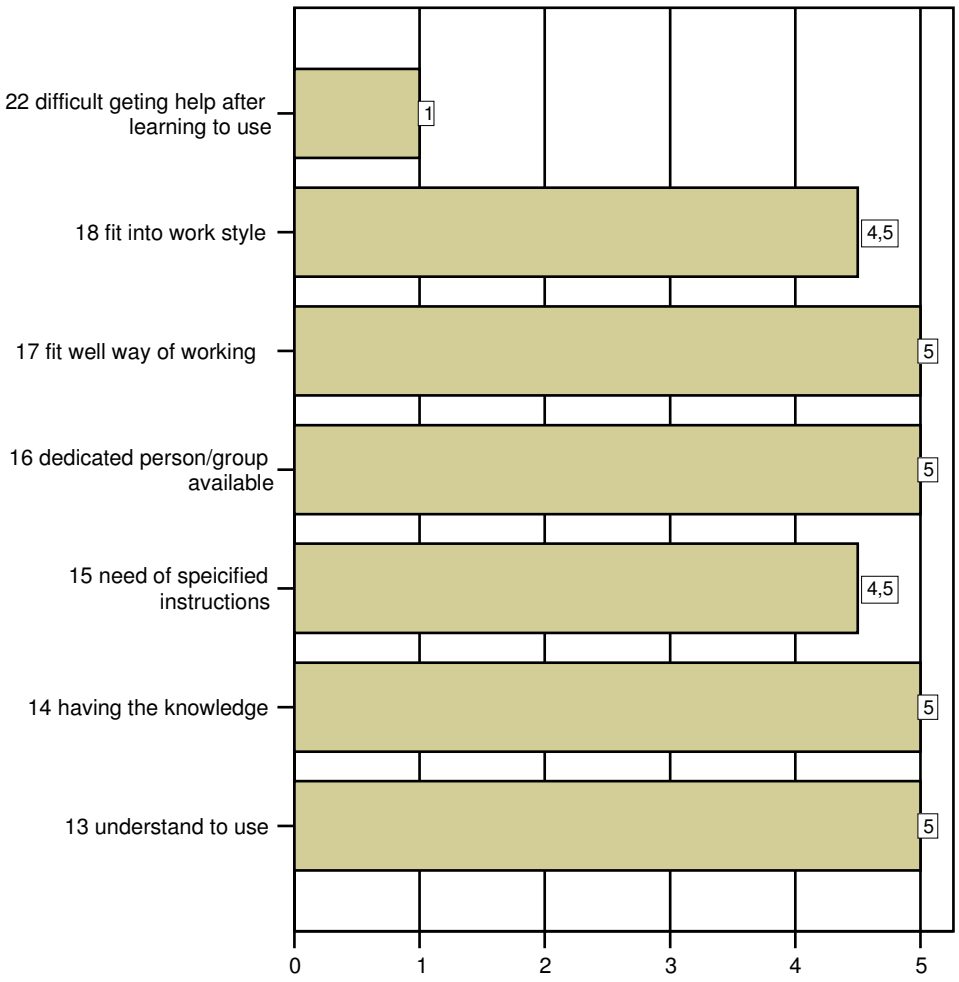


Figure 22. Facilitating Condition of the Acceptance1 score

Acceptance2

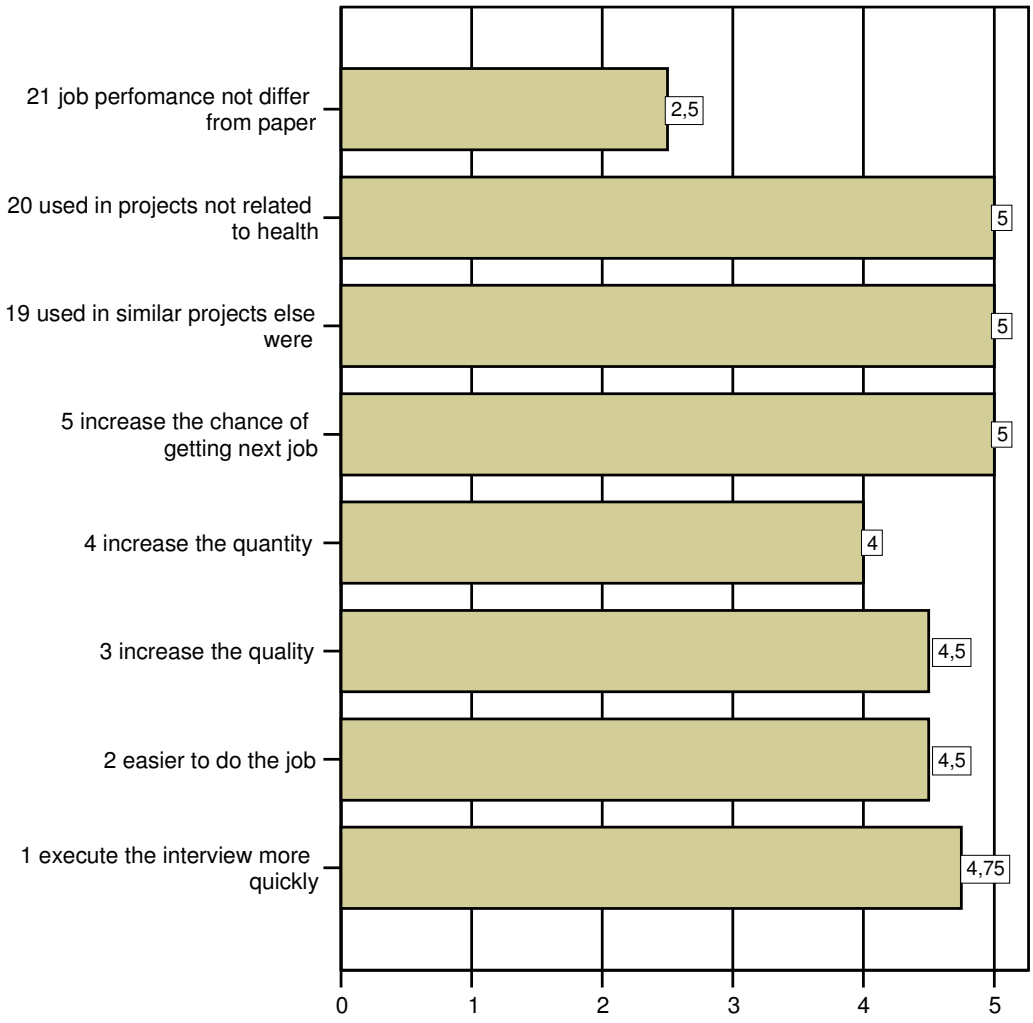


Figure 23. Performance Expectancy of the Acceptance2 score

Acceptance2

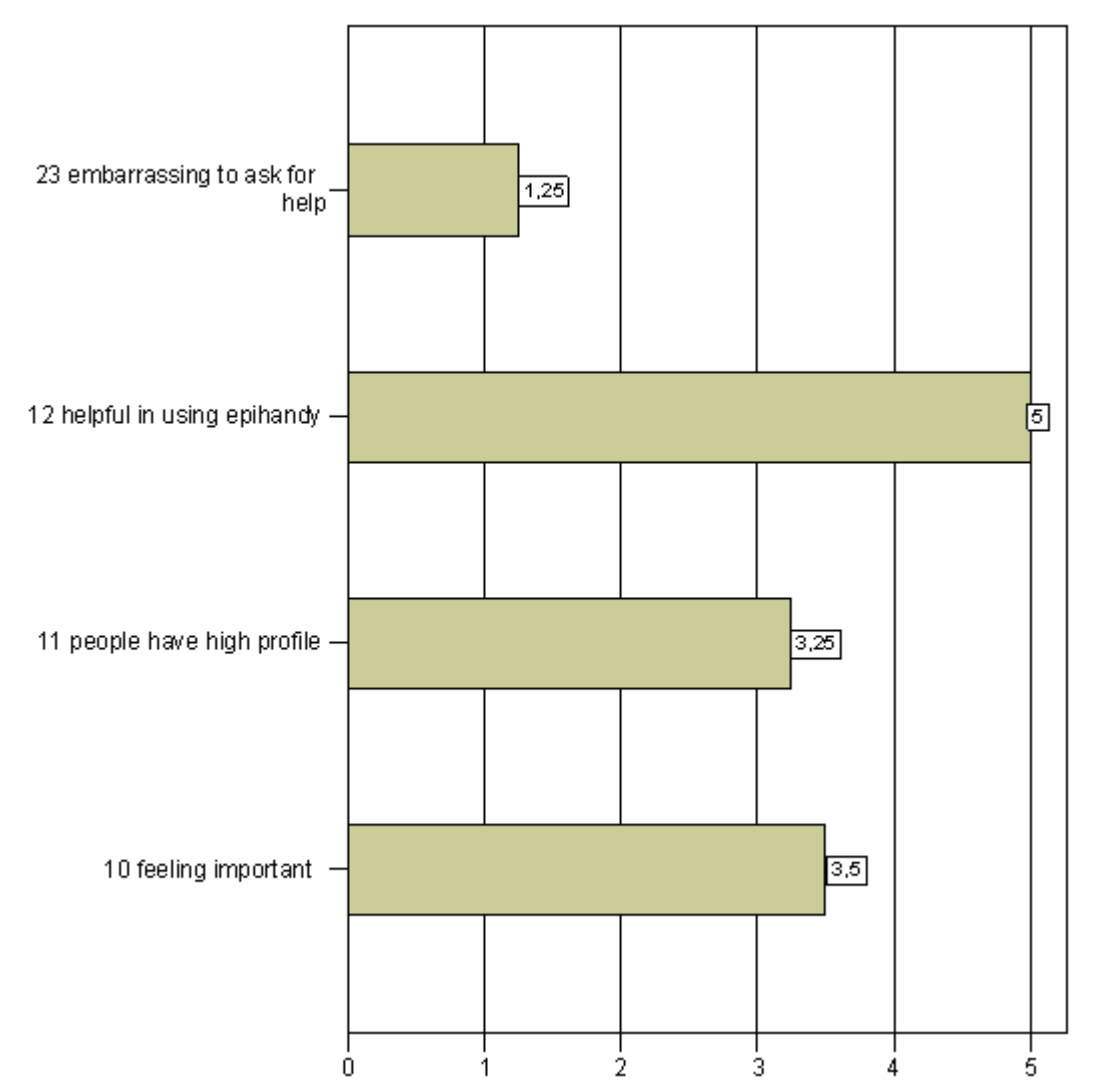


Figure 24. Social Influence of the Acceptance2 score

Acceptance2

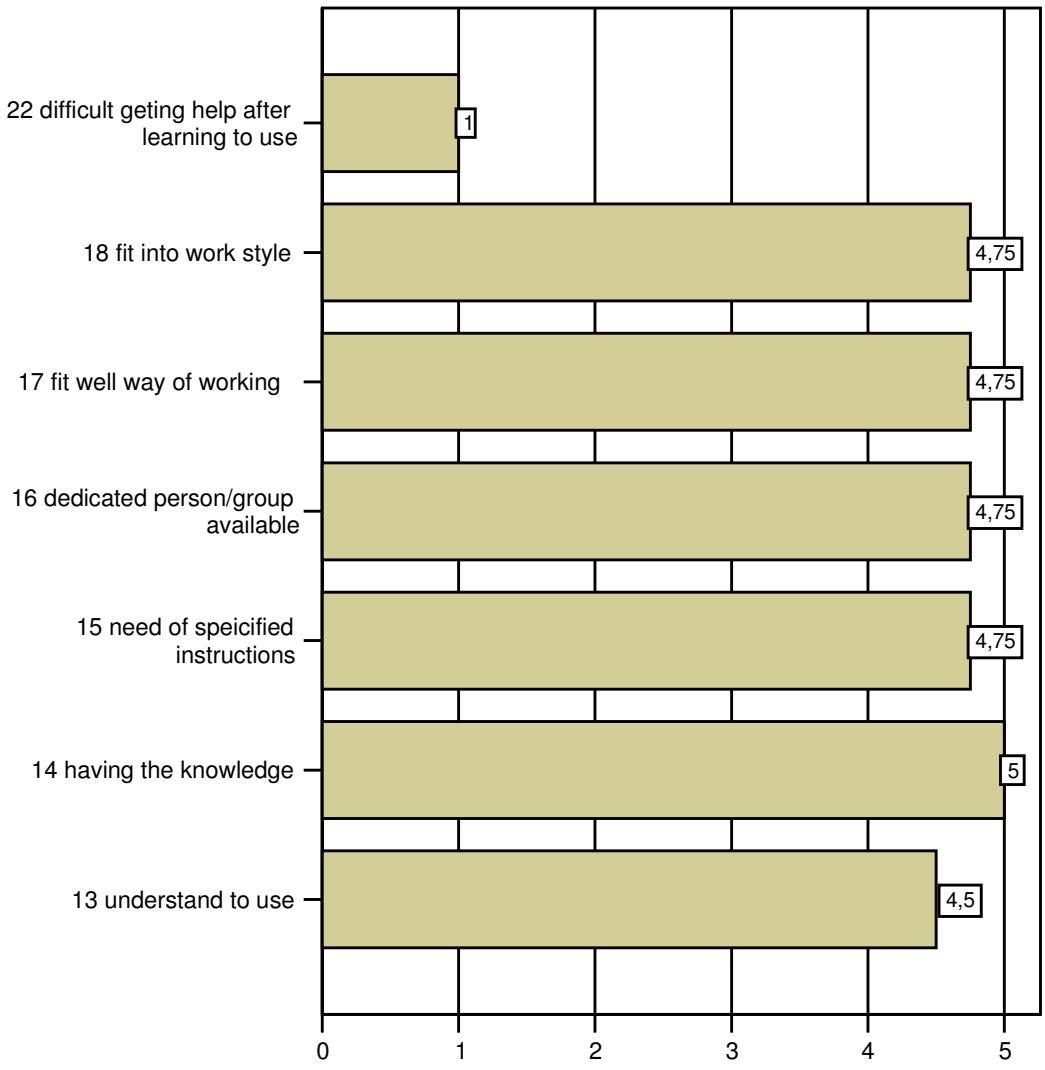


Figure 25. Facilitating Condition of the Acceptance2 score

Annex J Interview Guide; Depth Interview

Interview guide for Depth Interview with Data Collectors

Promise EBF

August 2005

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Makerere University
we build for the future

Question	Answer	Comments
Land	Uganda	
Town	Mbale	
Date		
Time		
Interview object ID		
Gender		
Age		
Profession		
Job description		
For how long time have you been familiar with EpiHandy?		

Learning to use EpiHandy and attitudes towards using it

1	When you heard that you were going to use electronic collection of data in this study, what was your immediate reaction?	
2	If you could describe yourself when it comes to learning new technology, what kind of type are you? a. Fast vs slow b. Low or high self-esteem?	
3	Does your job feel different when you use the PDAs compared to when you use the paper questionnaires? a. Will you please describe how b. and why?	
4	What was the hardest ting to learn when you used the PDA for the first time?	
5	Are there any differences in contact with the interviewee when you use the PDAs compared to when you use the paper questionnaires? a. Will you please describe how? b. Why do you think it is like that?	
6	Have you received any comments from participants using PDA and GPS?	
7	What is in your opinion the biggest advantage using EpiHandy?	

8	What is in your opinion the biggest disadvantage using EpiHandy?	
9	Based on what you know now about EpiHandy software, if you were the one deciding to use EpiHandy or paper, what would you have chosen? a. Could you please tell me your reason for this choice? b. Which criteria do you base this choice on?	
10	Is it something you have thought about while using EpiHandy that you want to give feedback on to the developers of EpiHandy?	
11	Is it something you have thought about while using EpiHandy that you want to give feed back on to the project leaders of PROMISE EBF?	
12	Is it something you feel that is missing in EpiHandy?	
13	Is it anything you are afraid of using EpiHandy as the only tool for Data Collection in the PROMISE EBF? a. On personal level? b. On study level?	
14	Thinking about your experiences from the PROMISE EBF, Validation-study and the errors we found, did you ever get upset, angry or disappointed about having to use this equipment?	

15	If you think of economy, what is your immediate reaction: Do you think it is cheapest to collect data using EpiHandy or paper questionnaires?	
16	Is it something else you want to comment about using EpiHandy?	