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MOBILE-BASED TECHNOLOGY FOR MONITORING & EVALUATION

A Reference Guide for

- Project Managers
- M & E Specialists
- Researchers
- Donors

CONTRIBUTORS

Mitesh Thakkar, Founder and Director, Fieldata.Org
John Floretta, Deputy Director, J-PAL South/CLEAR
Diva Dhar, Policy and Training Manager, J-PAL South Asia/CLEAR South Asia
Nikhil Wilmink, Policy and Training Associate, J-PAL South Asia/CLEAR South Asia
Sree Sen, Policy and Training Associate, J-PAL South Asia/CLEAR South Asia
Niall Keleher, Director of Research Methods and Training, Innovations for Poverty Action
Michelle McConnaughay, Survey Programmer/Computer Assisted Interviewing Coordinator, Innovations, Innovations for Poverty Action
Lindsey Shaughnessy, Data Coordinator, Innovations for Poverty Action

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INTRODUCTION

This knowledge product will be a reference guide for using mobile-based technology, and its associated benefits of real-time data sharing and data analysis; thereby enabling organizations, donors and citizens to use Monitoring and Evaluation (M&E) data for better implementation and delivery of projects.

The Guide is organized into three sections:

1. **Quick Start**
   Is mobile-based monitoring and evaluation for you? How to get started?

   This section provides brief pointers for researchers, project managers, and donors on the possibilities and applicability of mobile technology to their work; and how to get started with mobile-based monitoring and data collection tools.

2. **Mobile Technology: Options and Opportunities**
   How is mobile technology better than paper survey? What are your choices?

   This section explains the various components that make up a mobile-based data collection system; lists their features and functionalities; and provides case-studies that highlight the different ways in which mobile-systems can be applied in the field.

3. **Implementing Mobile Technology in Monitoring and Evaluation (M&E)**
   How to roll out a mobile system? What are best practices, dos and don'ts?

   This section addresses issues related to implementation–planning time-lines, estimating costs, training field staff, and ensuring data quality and security. Using an in-depth case study, it underscores common practical challenges you are likely to face and offers solutions to minimize these.

1. QUICK START

I'm a Field Researcher. I want to carry out a household survey (it's very long!). Can I use mobile-based data collection tools for it? How?

Yes, you can use mobile-based data collection tools for field-research – even for long and complicated household surveys.

A good first step is to ask some of the mobile-based data collection service-providers[1] to demonstrate their software or system or both to you, preferably using your survey instrument itself. Once you get to see one of these systems in practice, you can decide to set up the system in-house – if you have internal technical resources, or out-source it to a service provider.

Key considerations in selecting a software platform and service provider:

- **Survey question types**: Can the software or service provider or both integrate the kind of questions you require, such as tabular family rosters, pre-loading of data, skips, validations, complex multiple choice questions, location (Graphic Information Systems – GIS), media (photos), and open questions? How quickly can a paper-based survey be converted into a mobile format? How long does it take to modify or update the mobile-based survey instrument later?
- **Control and Management**: Can you manage the software or system yourself, or does it require ongoing support from the service provider? Can you update your survey instruments; control field staff access to the surveys and data; access collected-data in real-time; through the system? If you have to manage it yourself, what kind of technical skills will you require in-house?
- **Monitoring**: Does the software or system allow you to monitor and track your field staff in real-time while data is being collected?
- **Data Security**: What kinds of data security features are included within the software? Do these features meet your requirements?
- **Time-frame and Costs**: Does the software platform and service-provider fit your timelines and budget? What kind of mobile devices will you have to purchase? You may have to make some trade-offs in terms of your feature-requirements vs. timelines and costs.

[1] See reference list of Service Providers at the end of this document.

I'm a Project Manager at a mid-sized NGO. I want to monitor the activities of my field staff and projects. How can I use a mobile-based monitoring system?

An important factor in deciding how to deploy a mobile-based monitoring system is to determine whether your field staff members are full-time or part-time employees or volunteers. This will determine how much control you will have on the mobile-devices that your field staff will be using for collecting and monitoring data.

In general, for projects with large numbers of field staff who are informally connected to the organization, you can opt for an SMS-based system. This system will work with any mobile device, and your field staff can use their personal handsets to send in project data. This way, you do not have to invest in mobile devices. The downside to an SMS system is that, other than 'the phone number that sent the data' and 'sent date-time', you cannot audit the veracity of the data, i.e. was it collected at the project-site? Were the numbers reported correct? etc. Also, if large numbers of monitoring SMS's are being transacted per field staff, the running costs of an SMS system can add up.

For regular, full-time field staff especially at the supervisory and monitoring level, you can provide smart mobile devices[2] that allow for Mobile Apps with 'form-based interfaces' for data entry, location (GPS) tracking, and media (photos) and bio-metric data capture. The data collected through these Mobile-App based systems can provide strong audit controls because of the location and visual evidence that is electronically captured.

As part of your mobile-based monitoring activities, you can also collect data and feedback from your beneficiaries directly. To facilitate their participation you can consider toll-free IVRS (voice) or SMS services.[2] IVRS and SMS services tend to be resource intensive to set up, and running costs are transactional based, i.e. per minute or per SMS.

Key consideration in selecting a software platform and service provider:

- **Customizability**: How customizable is the software platform to your specific organizational needs? In general, it is avoidable to build a fully customized system, unless you intend to have an in-house technical team to manage it.

[2] See section on *Technology Options.*

I'm a Donor. I want my NGO beneficiary to better monitor and share their 'impact' data with me regularly. What can I do?

With mobile technology, your NGO beneficiaries should be able to provide you field-level data from their projects in real time. Having access to ongoing data, instead of one-time annual report, allows you to understand the real impact your support is having at the field level.

Also, by requesting 'anytime and anywhere' access to project monitoring data, you can introduce a higher degree of transparency and accountability, at each level, within your beneficiary NGO.

In general, monitoring and evaluation are seen as 'non-programmatic costs', therefore efforts to make monitoring activities more transparent and rigorous are limited. However, it is possible for organizations to switch to mobile-based monitoring and management systems within their existing budgets. A good first step would be to get your beneficiary NGO to estimate its spending on monitoring and management activities. They can then try to look for a software platform and service provider who can offer a monitoring solution within that budget.

In addition to mobile-based data collection for monitoring projects, your NGO may also benefit from integrating it with new social-media tools to reach out and garner support for its work. Therefore, over time, rather than being a cost center, technology-based monitoring and mobilization will be more of an investment for your organization to grow and become more effective.

There are a few open-source software platforms and service providers that your NGO can try out without incurring any costs (or minimal costs). A reference list of software platforms and service providers is available at the end of the document.

2. MOBILE TECHNOLOGY: OPTIONS AND OPPORTUNITIES

PAPER OR MOBILE?

How do you decide whether paper or mobile is a better format for your monitoring and evaluation activities?

Take a call based on which of the following criteria are important to you:

(a) Easy to develop and field-test questionnaires upfront

Paper

- Provides maximum flexibility in formatting the questionnaire
- Can be shared and developed in collaboration with others
- Can be printed and tested immediately

Mobile or Tablet

- Follow standard formats – to fit mobile or tablet screens
- Requires using software tools that make it difficult to collaborate
- Can be tested only after deploying mobile-devices in the field

(b) Allows for unstructured, impromptu notes and qualitative data

Paper

- Writing on paper is easier
- Field staff can fill in notes later on paper-forms
- Responses can be written in local languages

Mobile or Tablet

- Typing through keypad or keyboard is slow
- Local language inputs at time of data collection are difficult
- Handwriting recognition soft-ware is still in its infancy

(c) Manage large surveys across regions with large number of surveyors

Paper

- Logistics of printing and tracking paper-questionnaires is tedious
- Real-time tracking of survey work is difficult
- Survey questionnaires cannot be changed once deployed without significant re-printing cost

Mobile or Tablet

- Can be deployed remotely to mobiles or tablets. Survey work can be tracked in real time
- If necessary questionnaires can be changed even with surveyors in the field

(d) Data quality is paramount

Paper	Mobile or Tablet
♦ Cannot control or limit logical flow of questions on paper ♦ Can have issues in deciphering hand-written selections and text ♦ Requires data entry – another source of error ♦ Requires manual scrutiny of surveys to check for errors and missing data ♦ Effective monitoring–audit and tracking, of data can be a laborious and complicated process	♦ Set logical question flow–thereby making non-applicable questions hidden from surveyor ♦ Set validation checks for answers entered, prompt enumerators if answers do not match 'pre-filled' previous data ♦ Some data cleaning is already completed due to these features built into the software ♦ Real-time data checking, allows for prompt review of data quality and makes auditing and respondent tracking procedures more nimble

(e) Cost and Time

Paper	Mobile or Tablet
♦ No one-time 'hardware' cost ♦ Ongoing costs of printing, transporting and storing paper questionnaires ♦ Data-entry operations take significant time and resources–training, data-entry operators, transliterating local languages, ensuring quality through double data entry, and reconciliation through hard copy checks. ♦ Longer time-frame before data is available for analysis	♦ Initial one-time cost of mobile or tablet devices ♦ Additional costs for maintenance such as batteries and replacement due to loss of devices ♦ Ongoing data-plan costs, and service-provider costs ♦ Real-time access to data to monitor quality and progress ♦ Environmentally friendly as printing surveys is avoided

(f) Ability to collect new data types: Location (GIS), Media (Photos, etc.)

Paper	Mobile or Tablet
♦ Requires additional hardware devices such as GPS devices, cameras, etc., for collecting non-text data types ♦ Non-text data types difficult to integrate	♦ Single device with other multimedia such as GPS, audio, and video tools ♦ Non-text data can be integrated with text data in real time ♦ Real-time access to location, photos, etc., provide can collect text as well as tie ♦ verification

TECHNOLOGY OPTIONS

Mobile data collection requires four components (Figure 1).

1. **Hardware devices:** To enter data into.

   Mobile devices can range from 'low-end phones' that can only be used for phone-calls and sending SMS's, to specialized devices such as point-of-sale (PoS) terminals.

   Add-on devices: Mobile devices such as smart phones can also be linked to add-on devices such as bio-metric sensors, bar-code readers, NFC and RFID[3] chips to record data such as finger prints, inventory tags, Smart Cards, etc.

2. **Data collection software:** To control how data is entered into the device based on programmed formats and rules.

   Data collection software is mainly required for smart phones, tablets and notebooks, and it tends to be specific to the type of hardware device like Android phones, Windows Notebook, among others. In some cases the software is built-in with the hardware, for e.g. PoS terminals, or is not required, like in low-end phones for sending data through SMS or IVRS.

   Data collection software can be: (a) custom built; (b) licensed; or (c) subscribed to as a service platform.

[3] NFC = Near Field Communication; RFID = Radio Frequency Identification.

3. **Data transmission:** To transmit or transfer the field-level data to a remote location or a single central computer.

   Mobile networks allow data collected in the field to be transmitted through SMS, voice, mobile-internet, etc. With certain devices, like PoS terminals, data is transferred physically by hot-syncing cables.

4. **Data aggregation and analysis:** To receive, collate and analyze data.
   This can be done remotely through SMS, mobile-internet gateways on web-servers with online databases, or through local hot-syncing on local computers using spread-sheet, database or statistical software.

Figure 1 and tables 1 to 4 provide details about the various features and options available within these components.

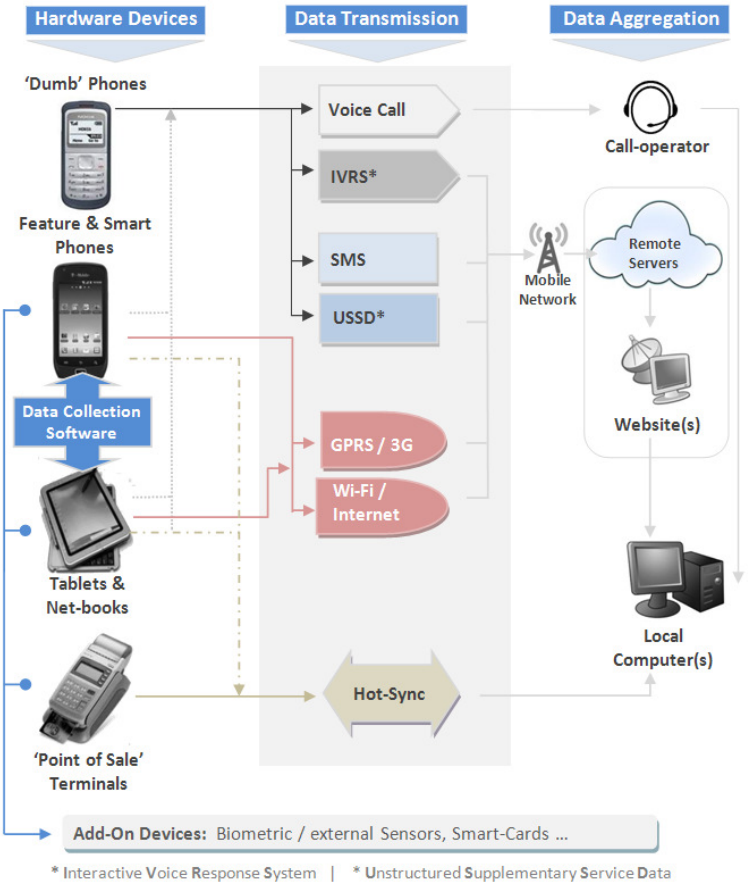


Figure 1 Different Components of a Mobile-based Monitoring and Evaluation System

Table 1: Hardware Devices: Options and Features

Options	Low-end Phones	Feature Phones	Smart Phones	Tablets	Notebooks	PoS Terminals
Cost	$15–$50	$50–$150	$150–$300	$200–$400	$300–$600	$150 +
Screen	Small Grey Scale	Small Colour	Touch Screen	Large Touch Screen	Large Screen	Small Grey Scale
Data entry	Keypad	Keypad	Touch Keyboard	Touch Keyboard	Keyboard	Keypad
Make Calls	Yes	Yes	Yes	Depends[4]	No	No
Send SMS	Yes	Yes	Yes	Depends[4]	No	Depends[5]
Mobile Internet	No	Yes	Yes	Depends[4]	No	Depends[6]
Internet (Wi-Fi or Cable)	No	No	Yes	Yes	Yes	No
Apps and Data Collection Software	No	Depends[5]	Yes	Yes	Yes	No
Track Location (GPS)	No	No	Yes	Depends[6]	No	No
Capture Photos and Media	No	Depends[5]	Yes	Yes	Yes	No
Connect to External Devices (Printers, Finger-print Scanners, etc.)	No	No	Yes	Yes	Yes	Yes
Hot Sync Data to Other Devices	No	Depends[5]	Yes	Yes	Yes	Yes
Battery Life	Full Day	Full Day	Half Day	8-10 Hrs	4-5 Hrs	Full Day
Device Models for Reference	Nokia 1203	Nokia C2	Samsung Galaxy Y	Google Nexus 7	Acer Aspire One	Custom Devices

[4] Requires a SIM card slot.
[5] Memory and functionalities vary with feature phone models.
[6] Some models do not have GPS-capabilities.

Table 2: Data Collection Software: Ownership Options

	Custom Built	Licensed	Subscribed
Ownership	You own it and can change it	You own it, but can't change it	You rent it
Set Up Time	Long	Short	Short
Set Up Cost	High	High	Low
Ongoing Costs	Medium	Low	Low
Customizability	High	None	Low
Upgradability	Low	None	High
Stability	Low	High	High

Table 2.1: Data Collection Software: Features Check List

Device or Operating System Compatibility	Which kind of devices or operating systems (OP) will the software work on?
Usability	How are questions, formats and rules created in the software? Does it require programming skills? Can it be created in-house, or does it require ongoing technical assistance?
Question Types	What types of data (questions) can be collected by the software, for e.g. text, numeric, single or multiple choices, date, time, photos, location, etc.?
Formatting and Organization	What types of display formats are supported by the software like tables and matrices, sections, single-page grouping, hint text, colored fonts, video or audio content, etc.?
Logic Functions	Does the software allow for logical, rule-based actions such as repeating of questions, skip rules, answer limits and validations, pre-loading of data, randomization, etc.?
Deployment and Storage	Can data-entry formats be updated remotely on the devices? How much data can be stored on the mobile devices? Can the data be edited after entry? Does it create back-ups?
User Management	How does the software control user access? Can multiple users access the same questionnaires, edit data, etc?
Security	Is access to the software password protected? Is the data encrypted?
Language Support	Can local (non-Latin) fonts be supported by the software for displaying questions, as well as data entry?

Table 3: Data Transmission: Options and Features List

	Call	IVRS[7]	SMS	USSD[8]	Mobile Internet	Internet	Hot-sync
Set Up Time	None	2-3 weeks	1 week	1 week	None	None	None
Set Up Cost	None	High: Record audio files	Low: SMS Gateway	Medium: USSD G'way	None	Low: Cable or modem	None
Ongoing Cost	High: Human Operators	High: Per Min	Low: Per SMS	Medium: Per Exchange	Fixed: Data Plan	Fixed: Data Plan	None
Demand Data from Device (Pull)	Operator calls out	Automated Outbound calls	Outbound SMS reminders	Not possible	Not possible	Not possible	Not possible
Receive Data from Device (Passive)	In-bound Calls	In-bound Calls	Inbound SMS	Receive USSD Code	Yes	Yes	Cable Connect
Push Data to Device	Out-bound Calls	Out-bound Calls	Outbound SMS	No	No	No	No
Send Data to Device on Request	In-bound Calls	In-bound Calls	Outbound SMS	Receive USSD Code	Yes	Yes	Yes

[7] **I**nteractive **V**oice **R**esponse **S**ystem: Voice instructions are provided over a phone call, and data is 'punched' into the phone's number-pad in response to the voice instruction, using number-based menu options.

[8] **U**nstructured **S**upplementary **S**ervice **D**ata: This is a menu-based SMS relay. It has to be initiated by the person with the mobile phone using codes that normally follow the format like *123x#. It is a service normally used by large organizations such as phone companies and banks because it is cost-effective only when subscribed to in bulk.

Table 4: Data Aggregation Options

	Remote	Local
Hardware	Web-servers	Desktops or Laptops
Set Up Time	Immediate to a day	Within a day
Set Up Cost	None	A local Computer
Ongoing Costs	Server and hosting costs	Local Maintenance
Data Security	High: Sites are configured for username and password-based access	Requires stringent access protocols on the local machine
Data Access and Sharing	Easy: Create additional user accounts	Difficult: Share password for encrypted data

Data transmission to web-servers from mobile devices requires subscription to mobile internet or data plans. Depending on the data-collection software, constant Internet access should not be required to store the data. The data can be stored on the device itself and transmitted whenever connectivity is available.

With local storage of data on the mobile device, unauthorized access and loss of data can be an issue. Some software packages encrypt the locally stored data, as well as store recoverable back-up copies of the data on the device itself.

CASE 1: MULTIPLE MOBILE OPTIONS

We Save Big (WSB), a micro-finance institution needs to monitor the weekly meetings of its Self-Help-Groups (SHGs). The paper-based weekly register-form filled by its loan officers is as follows:

SGH ID: 53 ***Mth:*** Dec ***Year:*** 2012		***Repayments*** (if absent, enter 'A')			
	Date:	6th	13th		
Member Name		***Week 1***	***Week 2***	***Week 3***	***Week 4***
1	Anita	350	500		
2	Bina	290	A		
3	Cony	A	560		
4	Deena	600	400		

We Save Big has 150 groups of 20 women each, and 10 loan officers who are in charge of 15 groups each. Over the next 2 years, WSB expects to grow ten-fold, and will have 30,000 women members, 1,500 groups and 100 loan officers.

Which one of the following three mobile technology options should WSB use?

Option 1

Device	Software	Transmission	Aggregation
Low-end Phones	None	SMS	Remote Server

(a) At the meeting, each SHG member who is present is asked to SMS the amount they are repaying that day to a central SMS phone number.

Example: The SMS sent by Anita will be: **r 500**
(r = repayment; 500 = amount)

- The message will route through an SMS gateway and the remote server will receive the data as: **mm/dd/yyyy 9876543 r 500** (where 9876543 is Anita's phone number).
- If the remote server already has the master data with all SHG IDs, their members' names, and the members' phone numbers, the data can be tabulated on the website as:

Date	SHG ID	Phone No.	Member's Name	Amount
mm/dd/yyyy	53	9876543	Anita	500

This data table can be used for report generation and analysis.

OR

(b) Instead of the SHG members sending the data, the Loan Officer (LO) is asked to SMS the following data to the server: **r 53 anita 500**

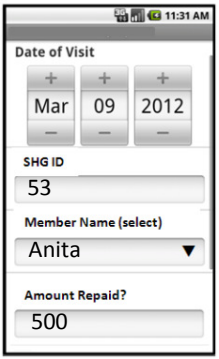
This data can be tabulated on the website as:

Date	LO Phone No.	LO Name	SHG ID	Member's Name	Amount
mm/dd/yyyy	3474234	Aysha	53	Anita	500

Option 2

Device	Software	Transmission	Aggregation
Smart Phone	Data-entry App	Mobile Internet	Remote Server

Each loan officer has a smart phone with a data-entry App. Software. The following questionnaire is available for data-entry:



This data gets transmitted over GPRS/3G, and when received on the server, the data is similarly tabulated, as mentioned earlier.

Date	LO Name	SHG ID	Member's Name	Amount
mm/dd/yyyy	Aysha	53	Anita	500

Option 3

Device	Software	Transmission	Aggregation
PoS Terminal	Integrated	Hot-sync	Local Computer

- Each loan officer has a PoS terminal with a Smart-card Reader, and all group members have Smart Cards.
- When repayments are made, the cards are swiped in the PoS, the Loan Officer enters the amount repaid, and a printed receipt is given to the SHG member.
- At the end of the week (or day), the Loan Officer hot-syncs the PoS terminal to a local computer when s/he visits the branch office.

ANALYSIS

Option 1 (a): SHG members send their repayment data by SMS during the meeting in the presence of the Loan Officer.	
Advantages	***Disadvantages***
♦ Will work with any mobile handset ♦ No hardware cost to WSB ♦ Low set up time ♦ Immediate access to data ♦ No additional costs for scale-up	♦ SHG members have to be literate and numerate ♦ Dependent on members having mobiles and numbers not changing ♦ Have to reimburse members for SMS cost ♦ Have to train members to use SMS ♦ Possibility of SMS entry errors ♦ Quality control difficult: members can send SMS anytime
Option 1 (b): Loan Officers send in SMS for each SHG member making repayments during the meeting.	
♦ Will work with any mobile handset ♦ WSB has control over devices and costs ♦ Low set up time ♦ Immediate access to data	♦ Strenuous for loan officers to enter SMS for each member ♦ Higher possibility of SMS entry errors (longer content) ♦ Additional reporting will require more SMS formats ♦ Quality control difficult–Loan officers can send SMS anytime ♦ Scale up will require new, low-cost handsets
Option 2: Loan Officers have smart phones with Mobile Apps for filling questionnaires.	
♦ Easy data-input interface, with error-checks ♦ Low set up time and immediate data access ♦ WSB has control over devices and cost ♦ Collect location or photo data for verification ♦ Better data quality	♦ Handset costs, especially when scaled-up to 100 loan officers ♦ Ongoing cost of subscribing to mobile data plans (GPRS/3G) ♦ Being expensive, higher possibility of handsets being stolen
Option 3: Loan Officers have PoS Terminals with printers and Smart-card readers.	
♦ Ease of use: swipe card, enter amount, print receipt ♦ Members receive a 'physical' confirmation ♦ Better data quality	♦ High cost of PoS Terminals and providing Smart Cards ♦ Logistics for distribution, replacement and control of Smart Cards ♦ Data not immediate, Terminals have to be hot-synced ♦ Tied-in to Terminal provider for support and maintenance

NEW DATA TYPES

Mobile data collection offers three new data types which can be very useful for monitoring and evaluation. These are as follows:

1. Geographic data – locations, paths, and boundaries
2. Multimedia data – photos, audio recordings, videos, etc.
3. Electronic sensors – fingerprints scanners, health-sensors, Smart-card readers, decibel-meters, etc.

1. GEOGRAPHIC DATA

With smart mobile devices such as phones and tablets, you can capture geographic data consisting of latitude, longitude and altitude of a point, a path or a boundary. With these three data types, you can abstract additional indicators using GIS[9] software to enhance your analysis. Some of these GIS indicators are:

(a) **Locations and verifications:** Mapping the location, path, area or boundary to a geographical region like location of surveyors at time of survey on a district level map; boundaries of a farmer's land; administrative boundaries of a district, and so on.

(b) **Prevalence and density:** Presence of certain activities or entities within a geographical boundary, for example number of pharmacies in a slum neighborhood; forest-cover (density) per square kilometer.

(c) **Areas:** Physical space occupied by certain structures, land, or activities, like average land area of schools in rural vs. urban areas; area of agricultural land encroaching forest land

(d) **Proximity and spread:** Distance between locations, instances and activities, for example distance of village schools from tribal communities; distribution of HIV+ cases in reference to national highways, etc.

(e) **Terrain:** Geographical attributes of locations and regions, such as average rainfall in areas with high incidence of malaria; life expectancy in high-altitude regions, etc.

(f) **Networks:** Identifying and quantifying connectivity, for instance the duration and distance of time between the first reported cases of Ebola; measuring road connectivity and density in terms of total length and crossings, and so on.

[9] Geographic Information System.

(g) **Change and progression:** Changes over time in (or between) a given location or region like rural-urban migration during the year; progression of students from primary school to university, vis-à-vis, location, etc.

CASE 2: GIS DATA AS PROJECT INTERVENTION

DELHI VOTERS PROJECT, INDIA

Project description and objectives

A randomized evaluation study was conducted in Delhi, India to test whether providing information to government officials and slum dwellers can lead to higher accountability and improved service delivery.

Two interventions were assessed as part of this project:

1. The effect of voter information campaigns on voter turnout and electoral outcomes
2. The effect of providing information on spending and quality of public services of elected officials responsive during election sensitive periods

Role of mobile-based data collection

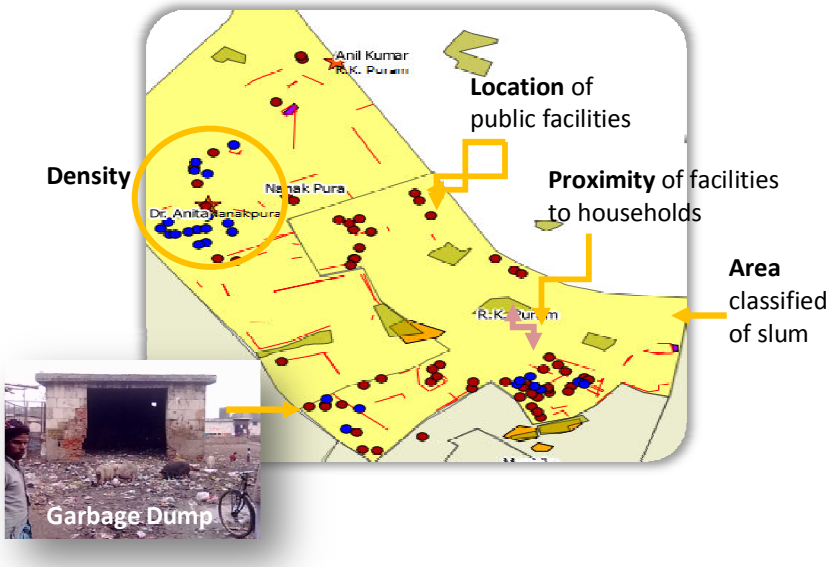
For the second intervention, field-based audits were conducted of garbage and toilet services in slums using smart phones. This audit consisted of the following GIS indicators:

(a) Location and verification of garbage collection points and public toilets in the slum areas

(b) Proximity and spread of public toilets to households and impact of toilet cleanliness on household health

(c) Area of a city councilors' ward which is classified as a slum

(d) Prevalence and density of expenditure on public facilities like street lights in 1 kilometer radius from the city councilors' residences.



These GIS indicators were mapped along with geo-tagged photographs (as shown above) and were presented to city councilors and community-based organizations.

MULTIMEDIA DATA

Photographs, audio recordings and videos provide rich qualitative data for monitoring and evaluation activities. Smart mobile devices using built-in components like cameras and microphones can capture this data easily. Multimedia data can also be used for audit and verification purposes.

CASE 3: MULTIMEDIA DATA FOR VERIFICATION

THE COMMUNITY ASSISTANTS INITIATIVE (TCAI), GHANA

Project description and objectives

The Community Assistants Initiative (TCAI) was launched in 2009 by the Ghana Education Service to improve educational quality in government primary schools by providing Community Assistants as support staff to schools through the government's National Youth Employment Program.

The Program had a randomized evaluation in-built study to measure the impact of the Community Assistants on children's attendance and learning outcomes. This required longitudinal tracking of close to 25,000 students over 2 years.

Role of mobile-based data collection

The TCAI research team deployed 120 field enumerators with feature phones to photograph and track the 25,000 children every year. During the first baseline, a database with individual pictures of the students by school was collated in real-time on a web-server. This list with photographs became an audit as well as tracking tool for the project. It allowed field supervisors to visit the schools to identify children who had been surveyed.

ELECTRONIC SENSORS

Mobile devices such as smart phones and tablets have built-in sensors such as accelerometers, microphones (can be used for measuring decibel level), light sensors, etc. These devices can be further enhanced by external add-ons such as fingerprint scanners, card-readers, motion detectors, air-quality sensors, etc.

With these kinds of sensors, monitoring and evaluation activities need not be limited to data collected through human intervention; rather lot of remote conditions and events can be measured by sensors and collected via mobile devices to better monitoring efforts.

BEYOND DATA COLLECTION: MANAGEMENT AND OUTREACH

Mobile-based systems for monitoring and evaluation are mainly associated with data collection, with information flowing from the field to a central management or evaluation team. However, the same technology can also be used to improve day-to-day operations, provide feedback to staff, and reach out to beneficiaries and other stakeholders.

Therefore, at an organizational level, mobile-based systems can and should be conceived not only as data collection tools, but also as management and communication tools.

Two critical organizational benefits of a mobile-based managed system are:

1. Taking informed decisions in real-time
2. Providing feedback and exchanging information between stakeholders in real time.

CASE 4: A COMPLETE MOBILE-BASED DATA MANAGEMENT SYSTEM

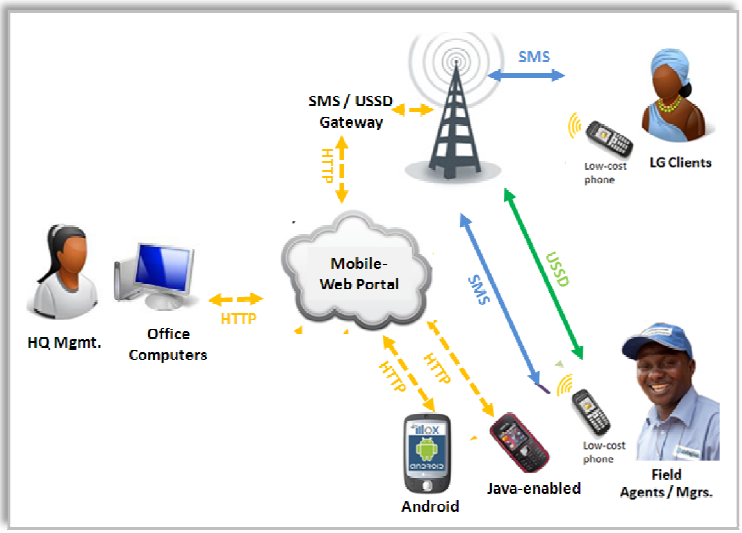
Living Goods is the *Avon of Pro Poor Products*. It operates networks of independent entrepreneurs who make modest incomes going to door-to-door selling affordable and effective solutions designed to improve the health, wealth and productivity of the world's poor.

Living Mobile, their in-house mobile management system, is a cornerstone of their scalability and sustainability strategy. By integrating *Living Mobile* into their door-to-door delivery system, Living Goods is building an end-to-end platform designed to increase demand, improve access, and reduce costs for delivering products that save and change lives.

A large component of *Living Mobile* is a two-way SMS communication system to interact with the micro-entrepreneurs and client-households. The SMS system is used for the following:

- Tracking health indicators and treatments-required by the client households
- Sending automated treatment reminders to client-households
- Informing field staff about new promotions, training schedules, and other activities
- Communicating educational materials related to Living Goods health products

For managerial and supervisory staff, *Living Mobile* consists of smart phones used by the staff for reporting their field-work, and also for accessing data which is live regarding their work. The smart phones are managed through an online portal with reports and dashboards.



SELECTING THE RIGHT TECHNOLOGY

How do you decide which is the right technology for your monitoring and evaluation activities? In practical terms, your options are limited to the following five combinations of the various technology components:

	Device		Software	Transmission		Aggregation
1.	Low-end Phones	→	Not Required	SMS	→	Local or Remote
2.	Low-end Phones	→	Not Required	USSD	→	Remote
3.	Low-end Phones	→	Not Required	IVRS/Call	→	Remote
4.	Smart Phones/ Tablets/Notebooks	→	Required	GPRS/3G (Mobile-net)	→	Local or Remote
5.	Notebooks/ PoS Terminals	→	Required	Hot-sync	→	Local or Remote

You can evaluate and select from these five options based on the following criteria:

Table 5: Technology Selection Criteria

	Low-end Phones + SMS	Low-end Phones + USSD	Low end Phones + IVRS + Call	Smart Phones + Internet	Notebook/ PoS + Hot Sync
	1	**2**	**3**	**4**	**5**
Purpose					
Monitoring ongoing projects and staff	◉	○	○	◉	○
Carrying out large surveys				◉	○
Verification/audit of field activities				◉	○
Communication/outreach	◉		○	○	
Provide real-time data to field staff	◉	○	○	◉	
Collect GIS/Sensor/Multimedia				●	
Real-time data analysis	◉	○	○	◉	
Duration					
One-off activities	◉	○	○		
Repeated ongoing activities	◉	◉	○	◉	○
Varying ongoing activities	◉			◉	
Scale of Implementation					
Large number of internal staff	◉	○	○	◉	○
Mainly external respondents	◉	○	○		
Small number of internal staff	◉			◉	
Budget					
Low set-up/hardware costs	◉		○		
Low-running costs	◉			◉	○
Local/regional constraints					
Low literacy/numeracy of field staff			●		
Limited mobile **network** availability					●
Limited mobile **Internet** availability	◉	○	○		○
Require non-Latin script			◉	◉	
Limited electricity/recharge for device	◉	◉	○	○	

● = Mandatory ◉ = Optimal ○ = Possible

3. IMPLEMENTING MOBILE TECHNOLOGY IN MONITORING AND EVALUATION (M&E)

Having covered how mobile technology can be used for monitoring and evaluation (M&E) activities, and the varied technology options that are available to carry out these activities, this section focuses on how to implement a mobile-based monitoring and evaluation system. It consists of a series of checklists and dos and don'ts for the various steps and processes entailed in the mobile-data collection process.

SELECTING THE RIGHT TECHNOLOGY SERVICE PROVIDER

Given that mobile-based data collection consists of varied components, it requires working with multiple technology vendors:

(a) Hardware providers selling phones, computers, etc.

(b) Software vendors for mobile applications for data collection and, if required, for data collation and reporting

(c) Data-transmission service providers for SMS gateway services, IVRS-telephony, and mobile-internet plans

(d) Web-hosting services for data aggregation and storage

In most cases, it will be easier and more cost effective to get a single service provider to manage all these components for you, even if they in turn have to source some of these services from other vendors.

With software being the core component, identifying the right software service provider is critical – whether you custom build the software, license it, or subscribe to it.

Key questions that you should ask of a potential software vendor:

1. Will their software work with the technology options applicable to you?

(a) Devices: Will it work with the *specific models* of the phones, tablets, or other devices that you intend to use in the field?

(b) Data transmission: How will their software transmit the data from the devices–SMS, USSD, GPRS or 3G, IVR-calls, hot-syncing?

(c) Data aggregation: How will data get aggregated? Where will the data be stored? In what format will the aggregated data be available for analysis?

2. Which kind of modules will their software contain?

Some generic modules that a mobile system is likely to contain are mentioned as under:

(a) Device application: Through which data will be entered and recorded.

(b) Form creation module: To create mobile forms and questionnaires that are to be filled by field staff.

(c) User management module: To control who can fill the monitoring forms and view field-level data.

(d) Data management module: For storing, viewing, exporting and importing data from the devices as well as other sources.

(e) Report modules: To view data in generic formats such as map-based views for tracking location data, etc.

(f) Security module: How secure is the software? What kind of security features does it provide?

3. How easy is the mobile system to use?

Does the software require technical skills like programming? How are the following activities managed within the software?

(a) Installation of the various software modules: Does the system work on a website or does it need to be installed on local computers? How is installation done on mobile devices?

(b) Creating questionnaires and forms: How much time does it take to create a data collection form? Can multiple users collaborate in developing the forms and questionnaires?

(c) Updating questionnaires: How often can surveys and forms be updated? Can field staff access updated forms in real time?

(d) Managing and controlling access: How can multiple users access the system? Can users be added, blocked, or removed easily? Is the system secure and protected in any way? Can you monitor who is sending data in real-time?

(e) Data aggregation: How is data from the field aggregated? Is it a manual or automated process? What format is the data stored in? Can data from multiple sources (not necessarily from the mobile devices) be integrated together in the system? How?

(f) Data export and reports: What kind of formats can the mobile system export the data in? Can data be exchanged with other software packages and systems?

4. Will the device application support the data types and features you require?

Use your existing paper-based monitoring forms and surveys to identify the data types and features you require. These can include:

(a) Question types: Text, decimal, integer, single choice, multiple choice, date, time, location, photos, audio, video, barcodes, signatures, ranking, etc.

(b) Formatting and organization of question display: Grouping of questions into sections, tables, or matrices; horizontal or vertical sequencing of questions on a single screen; display of instructions or hints; displaying audio or video content; formatted text–in bold, colors, etc.

(c) Logic functions: Does the software allow for logical, rule-based actions such as–repeating of questions, skip rules, answer limits and validations, pre-loading of data, randomization, compulsory answer required, etc.

(d) Language capabilities: Can the device application display and allow data entry in local languages?

5. How does the software vendor price their services?

Will the software vendor develop a customized system for you? Will it be a software package for which you buy licenses? Or will the software services be provided through monthly subscriptions?

Irrespective of the type of engagement model you have with the software vendor, you should clarify: One-time cost, recurring costs, cost of scalability (from few to large number of users), maintenance and support costs, and costs not included by the software vendor.

ESTIMATING COSTS

A common and critical question in deciding whether to switch from a paper-based to a mobile-based monitoring and evaluation system is *how cost-effective is mobile-based data collection*?

Cost effectiveness of mobile-based data collection will vary from organization to organization, and from project to project. However, the common costs to consider while estimating the budget for a mobile-system are as follows:

1. **Hardware costs:** Are your field staff full-time or part-time or contractual employees? How many field staff do you have? Is it better to purchase mobile devices for your staff, or to incentivize them to use their own devices?

   If you purchase mobile phones or tablets, you can amortize hardware costs by assuming the devices usable lifetime to be minimum 2 years, and breakage or loss rate to be around 5 per cent over the 2-year period.[10]

2. **Data transmission costs:** These are mainly recurring costs incurred by SMS, USSD or mobile-internet (GPRS/3G) usage. In certain countries, you may also incur one-time set-up cost for dedicated services such as SMS short-codes.

3. **Data aggregation costs:** These are recurrent costs that only apply if you use remote, web-based data aggregation and hosting. Your technology vendor or you will need to subscribe to a server-hosting (or cloud computing) service provider.

4. **Management costs:** The mobile-system will require an internal or out-sourced team to manage and support it. These costs will depend on the scale at which the mobile-system is being implemented.

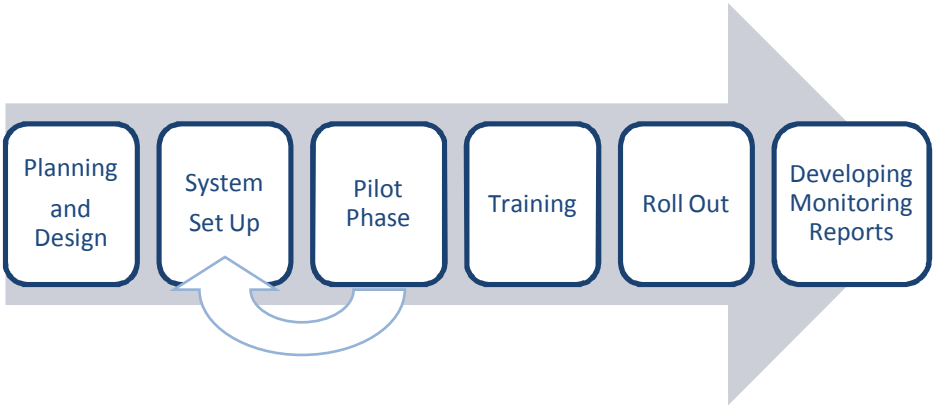
PLANNING TIMELINES

Planning timelines can be broken into two categories:

1. Ongoing activities like monitoring of projects
2. One-time activity like surveys

[10] Based on feedback from projects undertaken by Fieldata.org in 2012.

1. ONGOING ACTIVITIES: MONITORING OF PROJECTS



- **Planning and design phase**

  (a) The first step of any project should always be a thoroughly thought out *theory of change*[11] where the *outputs* and *outcomes* have indicators for day-to-day operations and monitoring that are clearly identified and measurable.

  (b) The format and frequency of how and when these indicators need to be collected has to be mapped out. This usually involves a field monitoring plan that details who will collect the data, when and how.

  (c) Once this framework is in place, a mobile-based data collection plan can be worked on.

  (d) If you already have paper-based monitoring forms and formats ready, this planning and design phase should not take very long. It is important, however, to involve field staff in this phase so they both understand the purpose and buy into collecting monitoring data.

- **System set up**

  (a) This is a technical phase; you will have to work closely with your vendor to set up the system as per your data collection requirements.

[11] Refer to Chapter 4 of 'The Road to Results: Designing and Conductive Effective Development Evaluations' by the World Bank Publication on *How to Apply a Theory of Change to your M&E Activities*, 01 June 2009.

(b) Best practice usually involves setting up this system in incremental steps, based on the feedback from the piloting phase outlined as under.

- **Pilot phase**

(a) During this phase, it is crucial to make sure the mobile system is accurately capturing the data sent by field staff.

(b) Any kinks in the process should emerge during this phase and you should provide extensive feedback to the technology vendor regarding the timeliness, consistency and accuracy of the data coming in.

(c) Once the basic data-collection process has been piloted successfully and is running smoothly, you can move on to training all your field staff on how to use their mobile devices.

- **Training**

(a) Use the same mobile devices you will be using in your survey to train your staff. Take your team through the complete process, including showing them their data being received in real-time.

(b) It is useful to have a monitoring manual prepared as well as paper print outs of the monitoring tools so that notes on how to collect monitoring data can be recorded.

- **Roll out**

(a) In case you are providing the mobile devices to your field staff, you will have to set up a logistics system to track your devices to prevent loss, damage or theft.

(b) Furthermore, you may initially have to rely on alternate sources of data to corroborate the timeliness and accuracy of the data being collected through the mobile system. For example you might initially want to have field staff noting down on paper what data is being sent each day, so that any discrepancies between what is being sent and received can be highlighted.

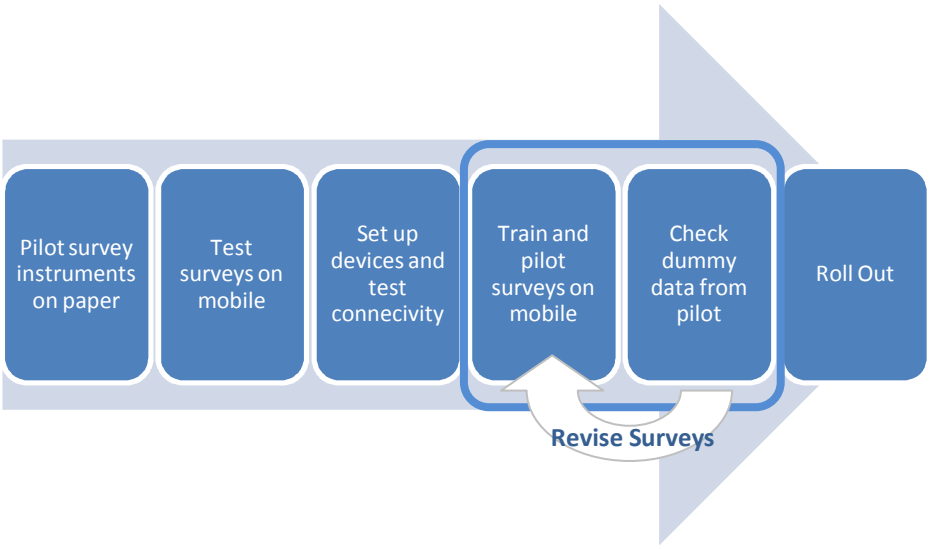
(c) Discrepancies between sent and received data may occur. This could be due to usability issues such as a human error; or some technical twists in the system. As previously stated, thorough piloting and practice can help resolve lot of these issues before data collection begins.

- **Developing monitoring reports**

  (a) Once your data-collection system stabilizes, you should have access to regular, raw field data to manage your operations and assess your programs.

  (b) Automated reports from the data can be created either through your software vendor or internally.

2. ONE-TIME ACTIVITY: SURVEYS AND RESEARCH STUDIES



For surveys and research activities, timelines are likely to be driven by external parameters, but you should plan for the following steps when estimating timelines:

1. **Pilot your research instruments on paper**

   (a) Test your surveys and other data collection instruments as per your research requirements first. This can be done using paper-based tools to ensure that your questions are correctly framed and they elicit appropriate responses.

2. **Set up and test the survey tools on mobile device**

   (a) Having finalized the content of your research instruments, programming them on the mobile-device application is the next step.

(b) Run mock surveys using a few devices to test question flow, connectivity and transfer of data.

(c) Check the aggregated data to ensure that the received data sets are complete.

3. **Set up devices and test connectivity**

(a) Install the mobile application on all the mobile devices that will be used by the surveyors.

(b) If you intend to use mobile-internet for data transfer, ensure that the phones can connect to the Internet. You may have to purchase SIM cards for all the mobile devices.

4. **Training, piloting and data checking**

(a) If possible, the training should include piloting the survey instruments using the mobile devices and software.

(b) This will familiarize the surveyors to the mobile device, the software and on how to troubleshoot problems with both.

(c) Once the surveyors are comfortable with the device and the software, get them to pilot the survey instruments and transmit the data in real time.

(d) Share with them the dummy data they have collected and elicit feedback and questions regarding the data collection process.

(e) If your software allows it, revise your mobile survey instruments on-the-fly, so that by the end of the training, the surveyors can take the mobile devices with them containing the final version of the survey instruments.

TRAINING AND PILOTING TIPS

- Initially use paper surveys with surveyors for them to annotate and make comments on questions.
- Once the survey team has familiarized themselves with the content and phraseology of the questions, the mobile devices can be introduced.
- It is always useful to have surveyors continue to refer to the hard copies of the surveys to keep in mind training tips and to refer to longer questions that may have been truncated in the software to fit the display screen.

- Prepare a training manual specifically on how to use the mobile devices and the software (along with a manual on the questions).
- Before the survey team is ready to use the mobile devices make sure the devices have the software with the most up-to-date version of the surveys in it, based on alterations made during field piloting and software testing.
- While training is going on, changes in the survey instruments will be inevitable. Ensure you have enough time set aside to incorporate these updates in the software.
- Have the survey team trained in how to delete and re-install the software. This way if they face any hardware problems, they can try to troubleshoot the issues in the field.
- Instruct the surveyors to keep a separate record of the surveys they have completed, saved and sent on a daily basis. Supervisors and project managers should tally actual data received with the daily logs maintained by the surveyors. Another option is to create mobile-based tracking forms for field supervisors to fill with the number of surveys reported to have been filled by the surveyors. This can be matched with the data received.

ENSURING DATA QUALITY

Data quality is enhanced when you can control or automate the flow of questions and data-entry process on a device. This makes data collection Apps on smart phones or tablets, IVR systems and PoS systems (with digital sensors such as Smart-card readers) more accurate than SMS entry on low-end phones.

To improve the data quality of SMS-based reporting, the following steps can be taken:

- Limit the number of fields required to be entered and reported through SMS. Breakdown large number of fields into multiple SMS messages, rather than squeezing them all into a single SMS.
- Provide a paper-based SMS format sheet for field staff to refer to.
- Send out automated SMS responses from the server to inform the sender that their data has been received and is correct, or that it does not conform to preset parameters and should be sent again.
- Regularly track the errors that field staff make in their SMS formats or answer-values. These errors can be highlighted during regular training sessions.

- If possible, standardize the low-end mobile handsets used by your field staff. Different handsets function differently and it becomes difficult to provide common instructions that work across the various types.

Software Features

To improve the quality of data gathered through smart phones and tablets, the data-entry software and questionnaires should be programmed with as many of the following functionalities as possible:

- **Sequential, single question display:** This forces the surveyor to focus on and fill in one question at a time.
- **Skip/piping logic:** Do not display questions that are not applicable. The questions should be displayed based on dependencies of previous answers.
- **Mandatory questions:** These questions cannot be left blank or skipped.
- **Input masks:** Control the number and types of characters that are entered.
- **Validation rules:** Similar to input masks, these are programmable rules that limit surveyors to entering 'valid' responses only, for example age limits.
- **Pre-filled, pre-loaded or auto-complete lists:** Specifically for identifier names or codes, if the data to be filled is available in advance (e.g. list of school names), it can be pre-loaded and displayed as a selection list, rather than have an open-ended text entry question.
- **Double-entry checks:** Repeat critical questions and enable automatic matching of the repeated answers to check for consistency.
- **Answer confirmation:** Prompts to confirm the answer that has been answered.
- **Error feedback:** If answers are incorrect, provide details of the error type.
- **Post-completion review:** Allow for review of answers after completion before sending data to server.

With mobile data collection you will have access to data in real-time, so additional quality checks can be made with the data while it is being received. Your analysis can look for missing data and outliers in the data while your surveyors are still in the field to take corrective action.

ENSURING DATA SECURITY

Data security is important for the sanctity of your operations, your stakeholders and your research participants. Your data may contain Personally Identifiable Information (PII) (information that can be used to uniquely identify, or locate a single person) and other sensitive data such as financial or medical information or both which should be kept private and inaccessible to most users of the mobile data collection system.

The potential security lacunae in the mobile-based data collection process and the possible corrective security protocols are as follows:

	Potential Security Gaps	Solution
Data Collection	♦ Data stored or backed up on the mobile devices	♦ If possible, use mobile devices that have 'lock and unlock' password protection ♦ For SMS data, ask field staff to delete SMS from sent folder ♦ For smart phones, tablets or notebooks encrypt locally stored data ♦ Encrypt PII data at time of entry
Data Transmission	♦ Readable data accessible by intermediary systems	♦ Encrypt data transmission ♦ For SMS data, get SMS gateway provider to sign confidentiality agreement
Data Aggregation	♦ Unauthorized access to data files ♦ Multiple copies being made of the data	♦ Use secure web servers or local computers ♦ Maintain a single, common repository that can only be accessed by ID/PW ♦ Do not use common passwords between users ♦ Track user-access to data and actions performed like data downloaded, etc.

Other general principles for data security:

- Differentiate PII and 'consent forms' from other information right from the beginning when data is being collected.

- Transmit and store PII separately. Use link or reference ids or both to match data sets with PII.
- Designate limited individuals who will have access to PII, and have them sign confidentiality agreements.
- If possible, avoid making hard copies of PII. Keep this data in digital format, at a single location that is password accessible.

AN IN-DEPTH CASE STUDY

MOTHER LITERACY PROJECT, INDIA: A FIRST HAND REPORT

The Mother Literacy Project was implemented by Pratham, the largest NGO in India, to explore how mothers' literacy and engagement with children at home can influence their children's learning levels. The impact evaluation of this Project was done by J-PAL[12] South Asia. The evaluation was carried out, from July 2010 to August 2012, in 240 villages in the state of Bihar and another 240 in the state of Rajasthan, covering a combined sample of 8,888 households.

1. Selecting the technology platform

After an initial paper-based census survey in both states a switch was made to a mobile-based data collecting system, consisting of feature phones (Nokia 2730 handsets), GPRS-mobile Internet transmission, and remote data aggregation on a web-based server. At that time, the decision to switch was experimental. It was primarily driven by an early demonstration by a known vendor of the feasibility of mobile-based data collection. After the completion of the study, the research team concluded that the initial time and monetary cost of buying phones, and developing and testing software was justified as survey operations ran much smoother without having to deal with large sets of paper print outs, scrutiny and data entry of paper-based surveys over the 1.5-year period of the study.

2. Estimating costs

The largest cost was the fee paid to the digital data collection company and their team of software developers who designed the custom made software and remained with the project throughout the survey periods as consultants. This was necessary for trouble shooting any issues with the application on the phones and data server. Additional expenditure included the initial hardware costs in terms of the purchasing

[12] The Abdul Latif Jameel Poverty Action Lab.

of 120 feature phones and extra accessories such as chargers, extension cords, etc. For mobile-services, a contract was signed with a telecommunications company for 120 SIM cards, with monthly billing charged directly to the project. Since voice-calls were not needed, incoming and outgoing calls were disabled, and only the mobile-internet (GPRS) and text message facilities were activated on the mobile-plans.

3. Planning timelines

Three months prior to rolling out the baseline surveys, phones and mobile-plans were purchased, software requirements were ironed out and tested, and the survey questionnaires were piloted at the time of training. The end-line, conducted a year and a half after the baseline, mainly required updates to the survey questionnaires and piloting those updates as the research team was already familiar with the software and phones being used.

4. Implementation challenges

The Project specific implementation challenges related primarily to conducting surveys in rural areas, as well as software and handset-hardware issues.

Implementing the survey in rural areas of Bihar and Rajasthan meant that the research teams had issues with phone connectivity. A rule was therefore established that the surveyors would save the data on the phones while in the villages, and the crucial step of sending and transmitting the data would be carried out by the team leaders (not the surveyors) at the end of the day from the field office. The team leaders also used paper-based tracking sheets to monitor saved forms, sent forms, and forms received on the server. This was required to address problems with data reported missing, i.e. data collected and saved, but not received on the server.

Hardware issues encountered related to phone-memory limitations in the Java-enabled feature phones. This arose due to 'pre-filling' and 'pre-loading' household information on to the phones. This was data that could be 'fetched' from the server onto the phones so that village names, village IDs, household IDs and respondent names would appear as options on the screens of the phones and the surveyors would simply have to select the correct respondent.

Initially, data of all villages and households was pre-loaded into the phone. During testing, however, the large amount of this data when loaded onto the phones via the online server caused memory issues, freezing the phones. The solution was to add in survey 'rounds' whereby data was again divided into rounds of six villages which the teams would visit based on the survey schedule. This resulted in a smaller subset of the data being downloaded on a weekly basis.

This issue highlights the importance of thoroughly testing the software using dummy data before the survey. In the Mother Literacy Project, in spite of piloting studies,

some memory issues arose which caused the loss of some surveys when phones froze. To prevent this issue from occurring in the endline survey, memory cards were installed in all the phones and the research associates were able to copy and paste backups on the memory card if the application ever crashed thereby ensuring data loss was minimal.

Finally another innovation which proved invaluable during the endline survey was the creation of specialized digital tracking formats which the team leaders (monitors) would have on their phones. When a household was completed in the field, the team leader would enter a digital tracking survey on their phones to track:

- How many surveys were either completed or not completed.
- The reasons surveys were incomplete.
- What quality check was performed by the team leader on the survey (spot check or full survey accompaniment).
- Whether a revisit was necessary due to incomplete information.

Occasionally households would have to be dropped from the sample and the reason the survey was dropped was also recorded in this tracking format. This tracking format was then compared to the actual data received on the server and any missing questionnaires were immediately identified and sent for a revisit.

5. Data quality

In the field the fundamental mistake we wanted to control was surveyors mistakenly selecting the wrong household on the device and thereby entering and saving information and respondent answers under an incorrect household ID. Checks were therefore put in the place in the form of double selection (or entry) of household names and IDs to make sure this was never occurred. Also, household roster print-outs detailing the village information and IDs, landmarks, family members and the required questionnaires to be administered to each household were also handed out to the surveyors for them to track the data on the phones to the paper roster.

Data quality significantly improved because of the survey data being available in real-time, at the end of the day on the web-server. This allowed the project managers to assess productivity of the surveyors as well as the quality of their data. Also, with the tracking sheets and back-checks, inconsistencies could be identified and addressed while the surveyors were in the field to take corrective action.

6. Data security

Other than the census data, which was done before investing in mobile phones, all survey data was collected and stored in electronic format. The mobile application was password protected, and the data collected on it was saved in raw string format.

While this data was not encrypted, it could not be interpreted without access to the server-based questionnaire-formats. Once the data was sent to the server, it was automatically deleted from the phone's memory. The data received on the server was password protected. This data was downloaded in csv/xls format, and upon downloading it was encrypted.

COMMON IMPLEMENTATION CHALLENGES

HARDWARE AND DEVICES ISSUES

- Purchasing of large number of mobile-devices: Local electronics vendors tend not to carry large inventories. So, if purchases are not planned in advance, you may have to buy different device models.

- Battery and charging issues: Mobile devices when used regularly require daily charging. In rural areas, with limited electricity, this can be a problem.

- Memory issues: Some mobile devices have limited memory which may result in data loss. Devices with expandable memory like SD Cards can address some memory issues.

- Set up issues: Mobile devices differ in the way Internet connections are configured. At times, mobile-network providers have to be contacted to assist in setting up mobile-Internet connections.

- Device depreciation such as battery problems, and broken and loss of equipment can be challenges. Putting penalties into the contracts of surveyors and monitors to make sure equipment is properly looked after is a common way to ensure equipment is well-looked after.

SOFTWARE ISSUES

- Upgrades and fresh installations: If the software is being customized or upgraded during deployment, it can create confusion with field staff and result in multiple versions of the software being used in the field.

- Security: Data stored on mobile devices can be accessed if not encrypted or password protected.

- Multi-media handling: Large amounts of multi-media data like photographs, etc., can delay transmission of data.

LOGISTICS ISSUES

- Set up issues: Activating SIM cards and mobile-internet facilities on hardware devices can take time, especially when mobile network providers require identification proof for each SIM card being issued.

- Billing and top up issues: It is difficult to track mobile usage by field staff, and staff using pre-paid mobile plans may complain about running out of mobile credits. On post-paid plans field staff may run up the bills by surfing on the Internet.

- Training: Field staff not only need training on the software being used, but also on how mobile devices work, and how to use them.

- Field staff switching SIM cards: Tracking field staff based on their phone numbers can become problematic because staff tends to switch SIM cards regularly.

- Theft: Mobile devices, being expensive and small, are easy targets for theft.

DATA RELATED ISSUES

- Data loss: While rare, this can occur due to mishandling of the software, deletion of the software or due to data transmission issues.

- Data of SMS forms are likely to have more errors compared to mobile App forms.

TIPS AND BEST PRACTICES

In addition to the many tips and best practices that have already been mentioned in the document, the following points are important:

- Set up your mobile transmission requirements such as SIM cards, and mobile Internet well in advance. This often takes time especially when large numbers of SIM cards are needed.

- In general post-paid connections (paid monthly) are easier to manage, as pre-paid connections need to be regularly recharged with credit. Field staff will not be able to send data if they do not have credit on their phones.

- Get field staff to sign off on a mobile usage policy, which explicitly mentions the cost burden of the mobile connections that will be borne by the organization, and those that will be borne by the staff. This will prevent misuse of the mobile connectivity for non-essential activities.

- Pre-piloting of survey on different mobile phones handsets is absolutely crucial. This includes:

  (a) Testing to see if the digital data collection application runs smoothly on the handsets

  (b) Making sure the correct local language scripts (where required) run on the handsets

  (c) Testing the survey thoroughly in the field and checking for bugs on different handsets is vital because making changes once it is on the server is much more difficult (piloting your survey can take up to 1 month depending on the length of your survey).

  (d) Customizations of your survey, making sure skip patterns and answer codes run smoothly.

  (e) Testing the memory of the phones by storing lots of data on the handsets to check the memory of the phones is important.

  (f) Sending completed surveys with 'dummy' data and reviewing the digital data on the server is crucial especially looking at the format of incoming data and whether it can be improved.

  (g) Finding out the battery life of the phones and buying the required extension cords to charge them extra batteries if required is necessary.

- When signing a contract with a digital data collection company, include a clause that says online data should be stored safely, password protected and encrypted/anonymized if possible.

- Finally a more general point: Paper vs. Mobile is not an *either-or* choice. You can mix both methods of data collection to suit your needs.

REFERENCE: SOFTWARE AND SERVICE PROVIDERS

Software or Platforms	Service Model			Support and Maintenance	Technologies Supported			Vendor(s)
	Customized	License	Subscription		Devices	Transmission	Aggregation	
Blaise		☑		Email/Paid Support	Computer-based	None	Local	Statistics Netherlands
CommCare	☑			Email/Paid Support	Android, Java Devices	GPRS/3G/Hot-sync	Remote/Local	Dimagi Inc.
EPISurveyor/Magpi			☑	Online/Email/Paid Support	Android, Java Devices	GPRS/3G/Hot-sync	Remote/Local	Datadyne
EPICollect			Free	Email	Android, Apple	GPRS/3G	Remote/Local	EpiCollect @ Imperial College, London
Fieldata.Org	☑		☑	Online/Email/Paid Support	Android, Java, Generic Mobile Phones	GPRS/3G/SMS	Remote	Arthify Inc.
Freedom Fone	☑			Online/Email/Phone	Mobile	IVRS	Local	Freedom Fone
FrontlineSMS	☑			Online/Email/Paid Support	Generic Mobile Phones	SMS	Remote/Local	FrontlineSMS
Kobo ToolBox	☑			Online/Email/Paid Support	Android Devices	GPRS/3G	Remote	Kobo Toolbox

Software or Platforms	Service Model			Support and Maintenance	Technologies Supported			Vendor(s)
	Customized	License	Subscription		Devices	Transmission	Aggregation	
Nokia Data Gathering			☑	Online/Email	Java/Windows Phones	GPRS/3G	Remote	Various
Open Data Kit	☑		☑	Varies	Android	GPRS/3G	Remote	Various
OpenXdata	☑			Varies	Android, Java, Generic Mobile Phones	GPRS/3G	Remote	OpenXdata
Pendragon Forms		☑		Online/Email	Android Devices, iPhone, iPad	GPRS/3G/Hot-sync	Remote/Local	Pendragon Software
PoiMapper			☑	Online/Email/Paid support	Android Devices	GPRS/3G	Remote	Pajat Solutions
RapidSMS	☑		☑	Varies	Generic Mobile Phones	SMS	Remote/Local	Arthify Inc. Find Dimagi Inc. Caktus Group
Surveybe		☑		Online/Email/Paid Support	Computer-based	None	Local	Surveybe