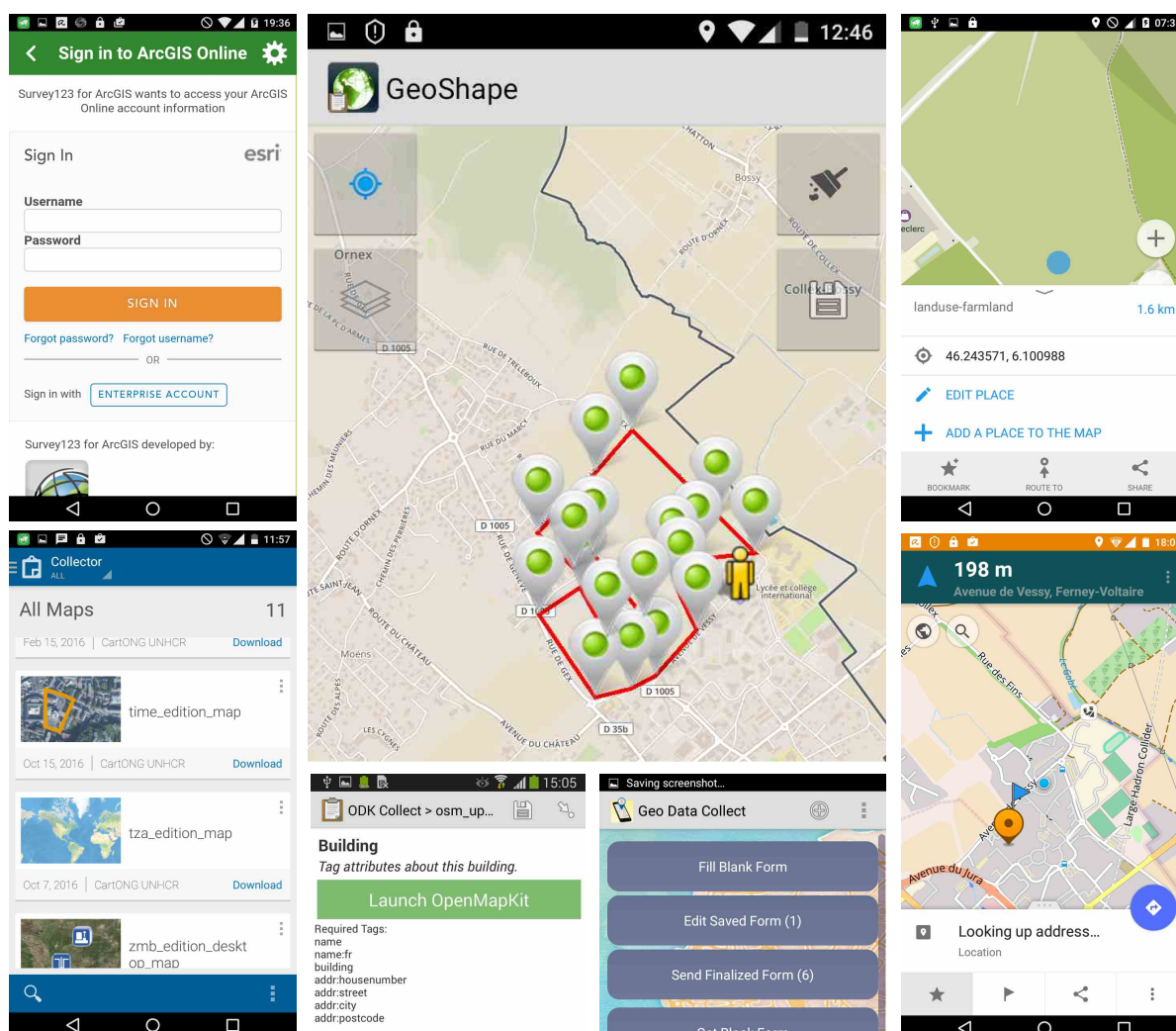




February 2017

MDC TOOLS WITH STRONG GIS COMPONENT



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Executive Summary
































































This benchmarking compares and contrasts different mobile data collection (MDC) tools that have a strong GIS component. The GIS component can be implemented very differently within each one of those tools which is why this document categorizes the tools into three groups:

- Simple Applications
- Advanced survey-centered applications
- Advanced map-centered applications

We come to the conclusion that there is not one mobile data collection application that will be the “perfect” solution for all field data collection efforts. But the different tools should be seen as being complementary to each other meaning that different applications are useful in different scenarios depending on

- a) The type of assessment: coordinated (standardized between different collectors) or uncoordinated data collection
- b) Server availability: Which servers are available/already in use or is there enough time and resources to allow a new server setup?
- c) Type of questionnaire: Is the focus on the form features (you need skip logic, cascading select questions etc.) or rather on the geographic and geometry information?
- d) Which output formats are needed: Is it best to have the output in a geographic database or rather as excel table?
- e) Should the data be integrated into OpenStreetMap

The table below gives an overview of applications and their most characteristic features¹:

	Assessment type  uncoordinated  coordinated	Form logic  OSM tags  Simple custom  Complex custom	Geometry  Points  Points, Tracks  all	Server required  No  Yes	Output formats  Geo-type only  CSV-type  Geo and CSV	Integration with OSM  none  possible
Maps.Me					 KML	
OsmAnd					 GPX	
ODK				 (ODK/KoBo)	 CSV (KML for Point)	
GeoData Collect				 (ODK/KoBo)	 GPX	
GeoODK				 (ODK/KoBo)	 CSV (KML for Point)	
OpenMap Kit				 (POSM)	 CSV and OSM	
Survey123				 (ArcGIS)	 CSV and GDB	
Collector for ArcGIS				 (ArcGIS)	 CSV and GDB	

The applications were tested between October and December 2016 and the exact version number of each tool is mentioned in the chapter on each solution.

¹ A more detailed comparison table of the tools is available in the annex.

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I. Introduction

Mobile data collection (MDC) tools are very commonly used in the humanitarian field for assessments and surveys. The need to do spatial analysis of the collected information and to link the data collected in the field with other localized information makes it often necessary to find tools that allow collecting more detailed geographic information. Therefore the present benchmarking looks at MDC tools which provide a strong GIS component. As mobile tools evolve fast, this document can only be valid for the date it was compiled. The testing of the different solutions took place between October and December 2016.

I.1. What are MDC applications with GIS component?

The tools explored in this benchmarking do not all support the same variety of question types and logic as available in KoBo or ODK. All tools however share the idea that the data collected in the application is displayed on a **map for offline use** and can **be integrated with other GIS tools or platforms**. This can be achieved by providing a common output format for geodata such as KML/KMZ or GPX or by providing a direct link to allow uploading data to platforms such as OpenStreetMap.

I.2. Categorization of applications

The applications presented in this document can be organized into three categories

- a) **SIMPLE MAP-CENTERED APPLICATIONS:** are quick to set up, have no backend server requirements, don't allow custom forms, integrate easily with OpenStreetMap, allow exporting points as KML or GPX. They are ideal for non-specialists who wish to collect only a few coordinates. In this category we looked at OsmAnd and Maps.Me
- b) **ADVANCED SURVEY-CENTERED TOOLS:** require KoBo, ODK or another server as backend, they allow complex² form logic. Those are tools that broaden the scope of the standard MDC applications to include additional geographic features. They are ideal for larger, standardized collections where the gathering of geo-information is one important part of the collection but not the main purpose of the data collection. These tools include ODK Collect, Open Map Kit, Geo Data Kit, GeoODK and Survey123 for ArcGIS
- c) **ADVANCED MAP-CENTERED TOOLS:** require a backend server, don't necessarily provide complex form logic but are more versatile in the collection of geodata. The approach to data collection is GIS-based where data is organized in layers and can be added, edited or deleted on the phone. This category currently only includes Collector for ArcGIS.

This categorization of available applications gives a first overview of what is possible with MDC applications with GIS component.

II. Category A – Simple applications

As mentioned in the introduction, this category includes applications that do not require any server setup. Such tools are ideal for non-specialists that wish to collect a few coordinates offline having a background map visible while working offline. Those applications are not designed to create entire assessment or questionnaire or have several users work together and share the information.

² "Complex form" or „form logic“ refers to certain features of X-form based applications. Those forms include the ability to skip certain questions based on previous response, to add constraints to a question to avoid invalid answers and more.

II.1. Maps.Me



Maps.Me is first of all an application that provides offline maps and routing functionality. But it has the additional functionality of allowing updates of OpenStreetMap data through the map.

Current Version	Maps.Me v. 6.4.3
Platform	Android, iOS
Website & Forum	Main site: http://maps.me/en/home
Provider	Mail.ru
Requirements	OpenStreetMap/Google account for map updates
Pricing	Free
Components	App only
Main strengths	<ul style="list-style-type: none"> - direct update of OSM data - offline use of OSM maps - easy sharing of point data (bookmarks) as kml
Main weaknesses	<ul style="list-style-type: none"> - no custom data collection containing several attributes (only OSM data model)
Standard Use Case	Non-GIS-Expert that also wants to collect a few points in the field to integrate into OSM or to share as kml

II.1.A. General workflow

Since Maps.Me does not have any server/cloud component it does not need much preparation before going to the field for data collection. The only thing necessary is to zoom to the area of interest in order to download the OSM data for the area while online. Once this is done data can be collected in two ways:

- a) Collection of bookmarks
- b) Collection of Points of Interest (POIs) using the OSM data model

a) The bookmarks can be used for anything that does not match the OSM data model such as comments on certain places on the map or border crossing points that do not exist in the selection of OSM features available through the app.

Those bookmarks can be added to different custom bookmark categories in order to structure the data. Other than that bookmarks only allow collecting coordinates, name, category and a description text for a point. There is no possibility to add further fields. These bookmarks are stored as kmles on the phone. When online they can be sent by Skype or email (or other apps allowing file transfer). They can also be exported from the phone manually to be opened in Google Earth or another GIS tool on the computer. When sent back and forth between different phones it is not the same file that will be edited but a new file will be created at each reception.

b) When using the "Add a place to the map" or "Edit place" the downloaded OSM data can be updated. Not all OSM features and tags are available through the app but only the most common ones. For example the features: community_center, shelter, drinking_water exist but

other categories like border crossing or office are not available and hence new border crossings can't be added to the map. For the tags defining a feature, not all options are available but only the most common ones. For example for the `community_center` it is possible to add the name of the operator or to add the opening hours. For a train station however the only available option is to leave a comment for the OSM community if there is anything to add or update. For any polygon or line features commenting will be the only option available to the user.

If OSM features were updated then those will be visible in about a few hours in OSM (except where only comments were left). However they won't be visible to other Maps.Me customers before the next release of Maps.Me as the maps stored on the phone are only updated with each release. This means that there is no near real-time visibility of the changes which is a drawback if collection is done by several people.

II.1.B. Geographic Dimension

The tool only allows collecting point data for bookmarks and OSM data. For polygons and lines it is only possible to leave a comment for the OSM community in order to update the information. While KMLs created with Google earth can be added to the map, KMLs including lines or polygons will not be visible in the app. Furthermore it is not possible to edit the location of existing OSM points. For this case as well the only option is to leave a comment for the OSM community to make them aware of the mistake.

II.1.C. Testing and user experience

The app has a simple and easy to use interface. Compared to OsmAnd, the next application in this category, this is certainly an advantage. Also the rendering of the OSM data is better adapted for display on mobile phones. This makes the app easier to use and more helpful if also other tasks such as navigation or orientation on the map are important to the user. What is a bit disappointing though, are the available options for adding and editing OSM data. Here OsmAnd is much more advanced.

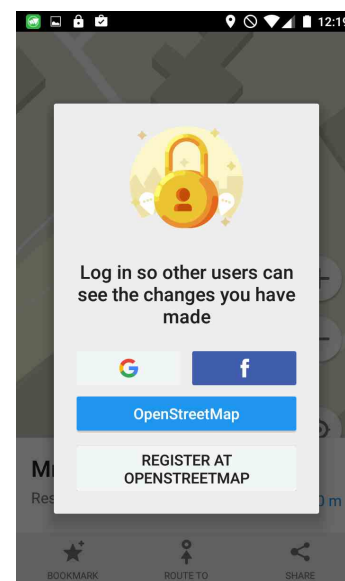
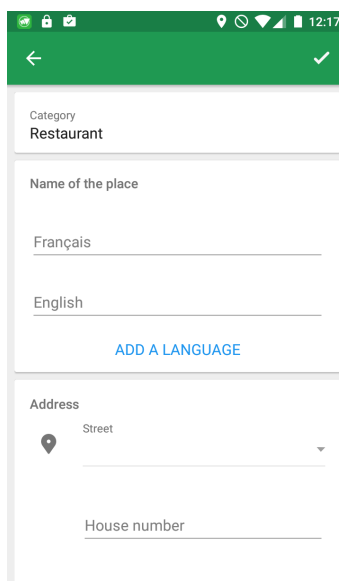
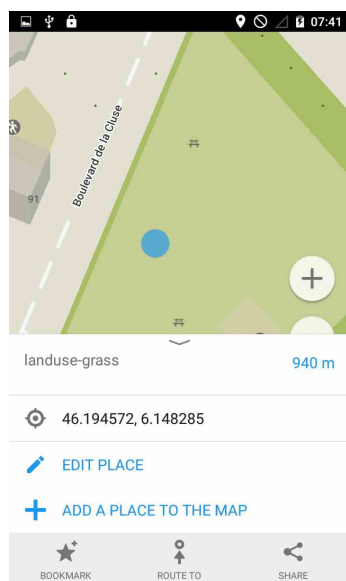
Furthermore the app uses battery life through background-processes as it constantly verifies the location even if the application is closed.

II.1.D. Conclusion

Maps.Me is certainly useful for a non-expert that wishes to collect a few points while in the field. Here the tool provides the ability to see the OSM data offline and collect or update information. However, the lack of certain features makes the use of the tool rather limited for larger data collection efforts.

OsmAnd, an application with similar features, allows to go further in the data collection of OSM data making Maps.Me only a second choice for uncoordinated OSM data collection. Nevertheless, Maps.Me provides the advantage of storing data in KML format which can be opened easily on the phone by people using the same application or on a desktop computer user Google Earth. This format is easier to handle than the GPX format of OsmAnd.

In addition, the better rendering of OSM data in the main map and fewer menus and buttons make the app less overwhelming and more appealing than OsmAnd especially when considering non-experts using the application.



II.2. OsmAnd

Just like Maps.Me, OsmAnd (OpenStreetMap Automated Navigations and directions) is first and foremost an application that provides offline map and routing capabilities using OSM data. Nevertheless, it provides additional plugins that allow for OSM data collection or creation of "favorites" that can be exported as GPX points.



Current Version	OsmAnd v. 6.4.3
Platform	Android, iOS
Website & Forum	http://osmand.net/
Provider	- open github project
Requirements	OpenStreetMap account for updates of OSM data
Pricing	<ul style="list-style-type: none"> - Free version: limited at 10 downloads (whenever zoomed to an area map is downloaded), - Premium version: 6€ with unlimited map downloads - F-Droid Version: free & unlimited downloads but fewer map updates
Main strengths	<ul style="list-style-type: none"> - direct update of OSM data - offline use of OSM maps - collection of POIs as GPX - tracking available
Main weaknesses	- no custom data collections containing several attributes

Standard Use Case

Non-GIS-Expert collects a few points in the field to integrate into OSM or to keep as GPX points

II.2.A. General workflow

OsmAnd is another app-only tool. There is no need/possibility to add a backend server to store the data. Hence it is only required to download the app to start data collection. When first zooming to an area a wifi/ data connection is required in order to download the map data. Once this was done, OsmAnd can be used for offline and online orientation, navigation and the collection of "map markers" - private bookmarks on the map. For editing the OSM data another plugin is required, called "OSM editing". Hence there are two options for collecting data:

- a) Adding a map marker to the favorites – for a private collection of data points
- b) Adding a POI – for collection of OSM data

a) To add a map marker, one just needs to click on a map location and add a little flag. The map marker will get the name of the address. When clicking on the map marker it can be added to "favorites" allowing to define a name, category and description text. These favorites are stored under "My Places". They can always be edited or deleted. Those markers can be exported as GPX files at a later stage.

b) When clicking on the map and choosing the "Create POI" option, data corresponding to the OSM data model can be added to the map. OsmAnd provides quite a large list of available OSM features that can be added (more than available in Maps.Me). The categories correspond to the main OSM tags for a feature such as amenity, man_made,... The advantage over Maps.Me is clearly that an "advanced" option is available allowing to add further tag-value pairs for the data collection which means that more custom tags like "refugee=yes" could be added using OsmAnd. By default only the name, category and information such as the opening hours and operator can be filled in. For every other tag the OSM tagging system needs to be known in order to add information on the point. Once all data is filled, it is first saved on the device and can then be uploaded to OSM at a later stage.

The points can be shared in different ways. It is possible to share one location by sending a URL including the coordinates (no attribute information). Otherwise data can be extracted manually from the phone as GPX points to either open in a GIS program or the JOSM editor. The POIs can be uploaded directly from the phone to OSM if a WiFi or 3G connection is available.

II.2.B. Geographic dimension

Data collection for both, POIs or map markers, is only possible for points. In order to collect tracks another plugin can be installed, called "Trip recording". This allows to collect waypoints which are connected to tracks. Those tracks as well as the point location of the map markers are stored in GPX format on the phone. They can be exported manually. The POIs are not stored in GPX format but integrated into an obf file which is unfortunately not a format that any other GIS software could understand.

Whichever type of point is chosen, POI or map marker, it is not possible to change the location of existing data. One would have to remove the point and add a new point with the same attributes but corrected location.

It is possible to add a variety of tiled basemaps to the map, some are already suggested on the phones but also other tiled services can be used. It is however not possible to download the tiles directly to the phone for offline use. Nevertheless the cache allows to keep tiles which have been used before available for offline use.

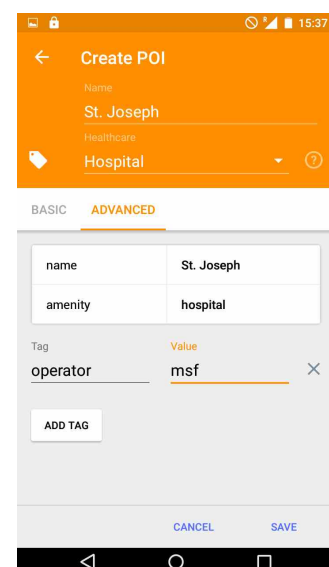
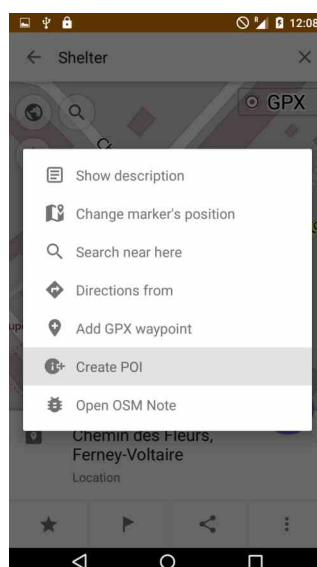
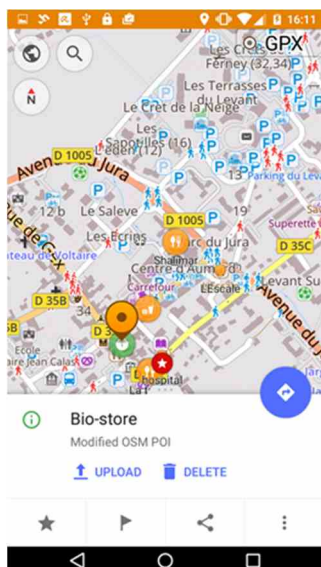
II.2.C. Testing and user experience

While OsmAnd is a very useful application the user is at first overwhelmed by the application: not only by the options that are available but also by the map itself which is overcrowded with information. The map includes all standard OSM features (though not all attributes). This on the small screen of a mobile phone makes it sometimes quite hard to find what you are looking for. For example, to have enough space to view street names on a mobile phone you need to zoom in a lot but then to pan around from one location to another makes you lose your orientation on the map as often no indications such as names of districts, communes or towns are visible at that scale. Also the search function makes it easier for you to find all streets containing "Geneva" than actually zooming to the city of Geneva,... This can be quite painful if you wish to use the map for more than just collection of data on your current location.

Once the users has gotten used to the map and the variety of menus and buttons, the data collection is actually quite simple. Collecting the POI or favorite is done by just pressing down the map and choosing the right option. In addition the POI menu which first allows you to fill in the simple OSM information and only if wanted gives you the additional options for more detailed OSM data collection where you can add tags yourself is quite well done.

It is a pity that there is no easy way to extract the POI data manually from the phone to use those directly in a desktop GIS tool such as ArcGIS or QGIS.

Through its plugins OsmAnd provides a much larger functionality than what can initially be seen. Being able to upload the data to OSM or exporting them as GPX is helpful and especially the option to add a variety of OSM tags makes this an invaluable app if OSM data is updated in the field. The draw-back is that the application seems overloaded with functionality and options. A second draw-back is that there is no easy way to manually export or save the POIs to a desktop computer. They are saved on the phone as *.obf file which cannot be read by other applications. While it is possible to save the POIs as gpx points and export those, this approach will make you lose all attributes other than the name. Therefore OsmAnd is only an option if the data is intended for upload to OSM and a wifi or 3G connection is available regularly.



III. Category B – Advanced survey-centered tools

The applications in this category are the ones that are closest to the well-known MDC tools. They are form-centric application allowing a variety of question types only one of them being questions on locations. To further illustrate the difference to tools from Category C, one should think about the standard GIS approach where everything is packed into layers. The applications of this category only support one layer at a time. Each questionnaire only corresponds to one table. While it is possible to store several geometries in this one questionnaire, only one of the columns can be chosen for the display in the end. For example it is possible to add a geotrace and a geopoint question in one form. However the output will be one table and hence one needs to decide whether it should be display as point or line. It is not possible to show both at the same time.

III.1. ODK Collect

It might surprise to see one of the standard mobile data collection apps in this benchmarking but ODK Collect now³ has gone farther to allow collection of geographic features and add a background map for offline data collection. Geoshape and Geotrace questions can be added to the form allowing the collection of line or polygon features within the form.



Current Version	ODK Collect 1.4.12
Platform	Android
Website & Forum	https://opendatakit.org/use/collect/
Provider	Open development
Requirements	ODK, KoBo or similar server
Pricing	- Free
Components	App (+ backend server)
Main strengths	- complex form logic - tracking available
Main weaknesses	- no editing of features once sent to the server
Standard Use Case	Fill in ODK form including geoshape and geotrace questions

As different servers can be used to store the forms and answers from ODK Collect, those won't be discussed further in this benchmarking. See the benchmarking of MDC Tools for more details!

³ Version from November 2016

III.1.A. General Workflow

A form following the X-form standards is created. This form can contain any number of questions of type geopoint, geoshape or geotrace. It is then uploaded to an ODK or KoBo server and from there published. Enumerators connect their phone with the ODK Collect app to the server and download the form. To have map tiles cached for offline use the user needs to zoom to the area of interest and pan around before going offline.

The enumerators then start filling the form. Whenever geoshape, geotrace or geopoint questions are asked the enumerator sees a map to fill these questions. Back with a WiFi connection the filled forms can be sent to the server from where they can be downloaded for more detailed analysis.

III.1.B. Geographic Dimension

Using geoshape, geotrace and geopoint allows the user to collect point, line or polygon features. While geoshape questions allow drawing a polygon on the map, the geotrace questions allow collecting a polygon or line feature using tracking.

The geoshape and geotrace questions are stored as text in the form, the syntax being: latitude1 longitude1 elevation1, latitude2 longitude2 elevation2,...

While these fields can be stored on the KoBo server they cannot be exported to KML-format directly. In fact, the GeoODK website⁴ (tool presented later) provides a converter to convert the data into shapefiles. The form can be downloaded and saved as csv and then uploaded to the XLS converter⁵ which will create a line or polygon based on a certain field as specified by the user. The output is a zipped shapefile which can then be used in any GIS software.

While there is a button on the map to select offline layers, there is no clear procedure yet explaining which format these layers should have and where it would need to be stored on the phone. For now it doesn't seem possible to store mbtiles or similar data on the phone for having an offline map background. Nevertheless map tiles that have been used while online, will be stored in the cache and then still be available for offline mapping. Hence, in order to have a map background, one should just zoom to the location while still online ensuring that all tiles that might be necessary for offline collection have been seen already and are stored in cache.

There are also different online basemaps available either from Google: Streets, Satellite, Terrain and Hybrid; or based on OSM: Streets, USGS, Stamen Terrain, CartoDB. Those can be specified in the General Settings under "Mapping Options".

III.1.C. User experience and testing

ODK Collect is a well-known and easy-to-use application. The geo questions are automatically opened in a map and the few buttons to track, add offline layers or save the feature are self-explanatory. The app goes farther than most of the well-known MDC apps when it comes to collection questions with geographic information.⁶

⁴ <http://geoodk.com>

⁵ <http://geoodk.com/xlsgeoconverter.php> (despite the name the converter accepts only csv files as input)

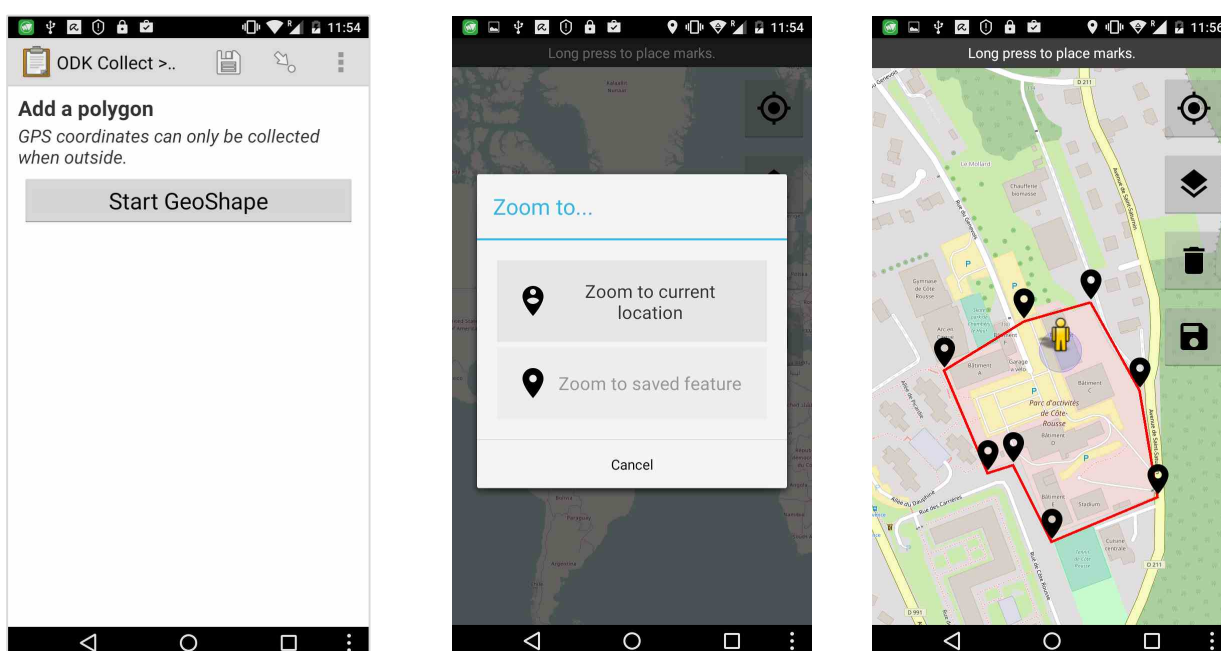
⁶ For more details on other features of ODK see the General MDC benchmarking.

III.1.D. Conclusion

It is great to see that one of the well-established MDC applications dives into the GIS world, adding various map options and support for polygon and line features. What is not yet up to date is the documentation on those new features. To find help on how to make additional offline map tiles available or similar questions, there is no information available on the website.

In addition, it's a pity that the format for storing the polygon or line features is not automatically readable by most GIS software. It is unclear why this format is used, while it would have been equally easy to store the polygon coordinates in WKT (well known text) format which is readable by QGIS for example. This would avoid two additional steps just to use the collected coordinates in a GIS application.

So while the app clearly has done a great step into supporting GIS data collection, there are still further improvements required especially regarding the offline map tiles and the export options for polygon or line features.



III.2. Geo Data Collect

Geo Data Collect is one of the Android applications that is based on ODK Collect but provides additional features for geographic data. In fact, the app is a hybrid between the ODK Collect and OSM Tracker application. Hence all form features are similar to ODK Collect while the tracking is similar to OSM tracker for Android.



Current Version	Geo Data Collect v 1.1.7
Platform	Android
Website & Forum	http://github.com/hotosm/Geo-Data-Collect

Provider	HOT Indonesia (and Australia-Indonesia Facilities for Disaster Reduction)
Requirements	OpenStreetMap account for map updates, ODK, KoBo or similar server to store forms
Pricing	- Free
Components	App (+server)
Main strengths	<ul style="list-style-type: none"> - complex form logic - link with OpenStreetMap - tracking available
Main weaknesses	<ul style="list-style-type: none"> - no link between the tracking and the form - no offline map tiles - no manual point collection
Standard Use Case	Track your location while filling in ODK-like form

III.2.A. General Workflow

A form is prepared for data collection according to the X-form standards. This data is then uploaded to an ODK, KoBo, ona.io or similar server. The enumerators download the form to their phones. In addition, it is possible to store mbtiles on the phone in order to have an offline map available for mapping.

Once application and form are downloaded to the phone, the enumerator starts tracking. While tracking his walk he/she can fill in the questionnaire. Giving his track a unique ID which he/she could repeat in the survey, the track and the form data could be linked manually at a later stage.

III.2.B. Geographic Dimension

The application allows to collect tracks. Those tracks can be uploaded to OpenStreetMap or exported in GPX format from the phone and then used in a GIS desktop tool. The collected tracks can be tagged to give more information on the track.

It is not possible to correct tracks manually or place points on the map directly. Hence the tool fully relies on the phones GPS for placing the waypoints. The tracks collected with Geo Data Collect can be uploaded to OSM directly from the phone.

III.2.C. User experience and testing

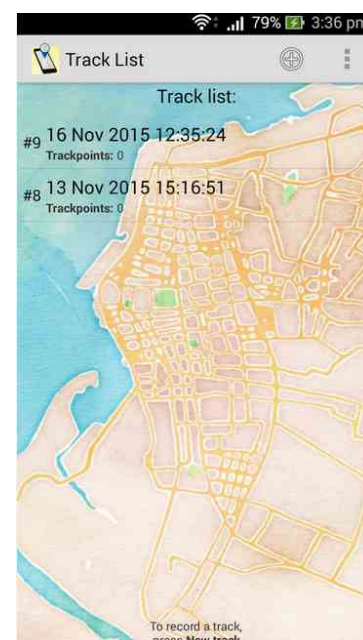
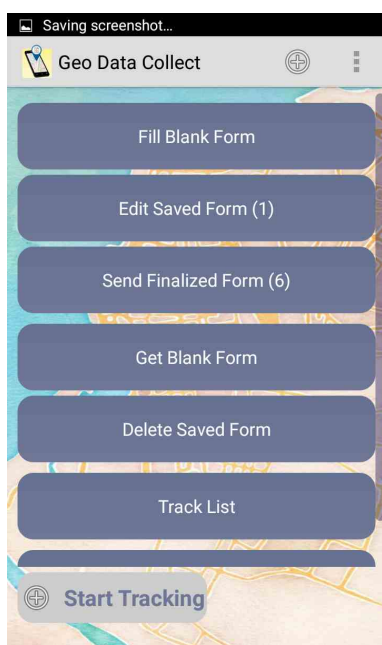
For users familiar with ODK the app is very easy to use. It provides the known ODK interface with just three additional options in the main menu: "Display map", "Track list" and "Start/End tracking".

While the application is very easy to use the user finds itself rather disappointed by the app. Having the ODK and mapping options in one application raises the expectation that the collected tracks and questionnaires are linked in one way or another. The app however leaves the tasks of linking each questionnaire to a track to the user which means that quite some

time will be required after the data collection in a desktop GIS. This is not only a frustrating task but also a probable source of errors and is therefore only a small improvement over a using a “GPS plus paper”-based approach.

III.2.D. Conclusion

This application is an admirable effort to bring together the functionality of the OSM tracker with ODK. Nevertheless, given that the task of linking the questionnaire and the track falls to the user, this application does not simplify data collection very much. In fact, data collection is as efficient as using OSM tracker and ODK separately while this would at least provide you with more options in the OSM data collection. Therefore, it is unclear which would be the use case where this application could bring an added value compared to any of the other tools presented in this benchmarking. Especially now that ODK itself offers the option of drawing line or polygon features which are part of the questionnaire there seems to be no advantage in using Geo Data Collect over ODK.



III.3. GeoODK

GeoODK is another app based on ODK but provides additional functionality for working with geographic data. Similar to ODK Collect, GeoODK stores the geoshape or geotrace questions inside the form. It provides no easy integration with OSM.



Current Version	Geo ODK
Platform	Android
Website & Forum	http://geoodk.com
Provider	University of Maryland

Requirements	A server such as ODK or KoBo
Pricing	- Free
Components	App (+ server)
Main strengths	- complex form logic - tracking available
Main weaknesses	- integration of the geo-type questions into GIS tools requires several steps
Standard Use Case	Fill in ODK-like form including geoshape and geotrace questions

III.3.A. General Workflow

A form following the X-form standards is uploaded to a KoBo, ODK or similar server. The application and form is downloaded to the phone. The enumerators then start answering the questions according to the form logic, whenever geopoint, geoshape or geotrace questions are asked a map interface is visible allowing to see the tracking or draw on the map directly. In addition, mbtiles can be put on the phone to have map tiles available for offline data collection.

Once a WiFi connection is available the collected information can be sent to the server. The map will still show all features collected (even after the answers were sent to the server) which allows to keep track of the collection progress.

In addition, it is possible to go back to the point features on the map and edit them again. If the "corrected" data is send to the server, both files will be at available on the server. So if only the last edit should be kept, a field identifying the features would need to be placed in the form and the older data deleted manually at server level or in a GIS software used later on in the process.

III.3.B. Geographic Dimension

The great advantage over standard ODK Collect is the option to see mbtiles displayed in the background. Furthermore, it keeps track of the collected data, meaning that data is still visible in the general map even after the form was send to the server. In fact, for geopoint questions, depending on the settings, it is possible, even then to go back and edit the information collection. The form can then be sent to the server again.

GeoODK also provides an online and desktop converter that takes a csv as input and allows to output a shapefile of the collected data. From KoBo, Formhub or ODK Aggregate the data first needs downloaded as csv. This file can then be used as input for the conversion. While the online converter only allows converting to shapefile the desktop converter offers KMZ and shapefile as output format.

III.3.C. User experience and testing

While the general application is quite similar to ODK Collect the general interface is slightly different which means that the user enters by seeing the map and the features collected so

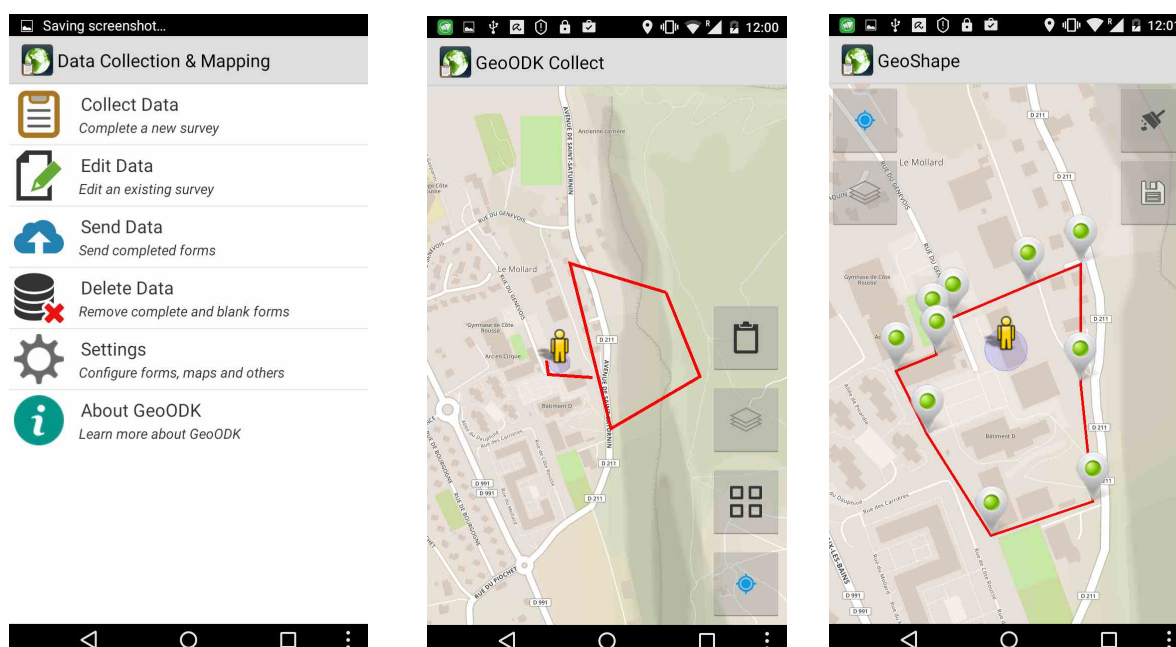
far. Some features of the menu have changed places compared to ODK which might be a bit confusing for the well trained ODK Collector.

Nevertheless, the app is very easy to use and all options are straight-forward. While it is nice to see all collected the features displayed at startup, it would be helpful if different styles or colors were used for different forms.

III.3.D. Conclusion

With the new version of ODK Collect allowing the collection of geotrace and geoshape questions the two applications are actually very similar. There are three things where GeoODK still has an advantage over ODK Collect:

- It is possible to add offline map tiles
- It is possible to view all collected data on the map outside the form.
- It is possible to edit point data and all its attributes after it has been sent to the server



III.4. Open Map Kit

The last but not least of the apps that adds on to ODK Collect is Open Map Kit (OMK). It was developed by the American Red Cross and specifically tested for humanitarian field data collection that is intended to not only collect survey information but also improve the OSM data for the surveyed areas.



Current Version	Open Map Kit
Platform	Android
Website & Forum	Main site: http://openmapkit.org/
Provider/Developer	American Red Cross

Requirements	ODK Collect on phone and a POSM server instance (cloud or local)
Pricing	App for free but cost of POSM server instance (either fully offline or set up on a cloud instance)
Components	App + Server
Main strengths	<ul style="list-style-type: none"> - update of existing geo-data - automatic sync with POSM server - very easy integration with OSM
Main weaknesses	<ul style="list-style-type: none"> - No polygon/line drawing - little documentation onf server setup, maintenance, debugging - not intended for collection of Non-OSM geo-data
Standard Use Case	Filling in an ODK survey in the field, including questions which will update and add information to be made available in OSM.

III.4.A. General Workflow

After the server has been set up, the survey manager will need to prepare the data collection by loading available OSM data of the area to the portable OSM server (POSM server)⁷ through the HOT export tool. He/She will then need to create a "Field Atlas" – this atlas can then be used to have an offline map visible on the phones. In addition a questionnaire needs to be created according to the X-form standards but containing additional osm-type questions to refer to the questions filled in with ODK. The finalized form is uploaded to the server.

The next steps will be done on the phone. The user first downloads ODK Collect and ODK to the phone – both are available in the play store. In the application he/she then needs to download the Field Atlas and xml data for offline collection. Last but not least he will need to connect the ODK Collect app with the ODK server instance to download the form.

Once this is done collection can start. The enumerators will start filling in the form in ODK. When an osm-type question occurs in the form the user then sees a button asking to "Launch OpenMapKit". The osm-type questions can for example include questions on the osm building type with drop-down options, the building levels as integer or similar questions. The enumerator can either collect a new node or update an existing one. It is not possible to draw new polygon or line features on the map. Once the OSM questions on the feature have been answered, the user will automatically return to ODK for any remaining questions.

Once back online the surveys can be sent to the ODK server. From here the data can be downloaded. While the ODK answers including an ODK ID can be downloaded as json or csv, the osm-data can be downloaded as *.osm file only. There is no data visualization available at server level. To view the data it would need to be downloaded to the desktop and opened in QGIS (as QGIS can read osm-files) to prepare any maps or visualizations.

III.4.B. Geographic dimension

Given that ODK Collect now also allows collecting polygon or line features, the actual added value of OpenMapKit is not the ability to collect geographic features. Those options are actually

⁷ <https://github.com/AmericanRedCross/posm>

quite limited not allowing to draw lines or polygons on the map. The added value is the easy integration with OpenStreetMap. For a certain area of interest, the best workflow using OMK is to draw all required polygons or lines with an OpenStreetMap editor (e.g. JOSM) based on a satellite image and then go to the field to fill in the attribute information for the area of interest and adding additional nodes where necessary. This can be a valuable workflow when only OSM data should be updated by field teams or if this is done in addition to an ongoing survey.

As mentioned above, the app allows downloading “field papers” to the phone. This is basically an image of your area of interest, which is loaded in the background to make the app more appealing. The actual xml data however is what you work with. Furthermore it is possible to download mbtiles for displaying an offline map.

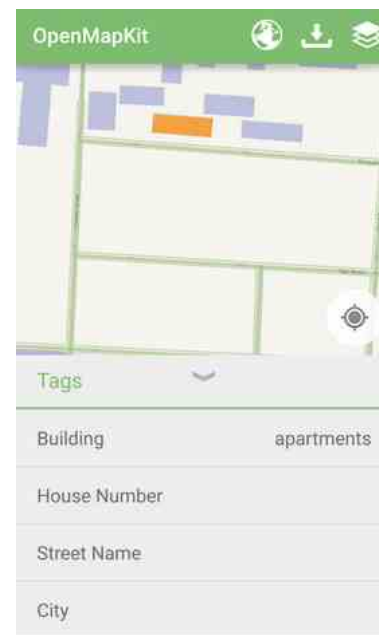
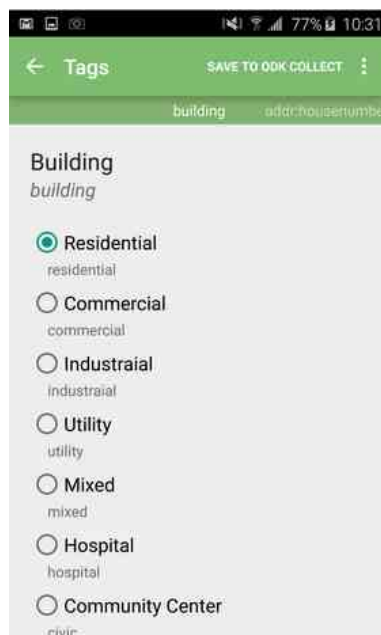
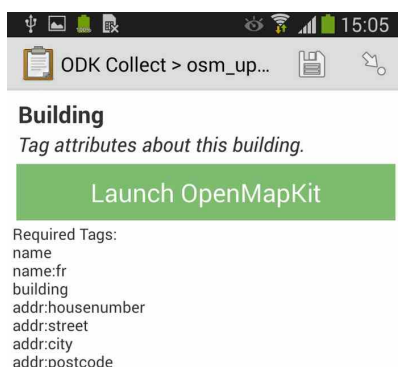
III.4.C. User Experience and testing

In order to use OpenMapKit it is key to understand it's interaction with ODK Collect. The user will normally start each collection in ODK and only for the geographic features will he/she move to OpenMapKit launching it from within ODK Collect. The user interface is very simple and easy to use. For detailing the attributes of points of interest this can be very valuable. It is a bit disappointing though that you cannot directly draw polygons and lines on the map. During our testing we had a few problems when loading the field papers or XML data in OpenMapKit. This might have been due to the fact that we tested with a very narrow server setup being below the suggested threshold. This however points to a limitation of OpenMapKit as it requires a developer who can set up the server, do maintenance or debugging work where needed. These steps are more complicated than in other ODK servers, especially if compared to Kobo (where everything is set up and only registration is required) but even compared to ODK Aggregate where the VM setup is well documented and relatively easy to do.

III.4.D. Conclusion

This app has a different approach to collection of geo-data than most of the other tools we presented here. The workflow to use OpenMapKit assumes you will do up-front work to digitize the necessary data from a satellite image and that mostly attributes not geometries are collected or updated in the field. In addition, only if you are ready to share (part of) your data on OpenStreetMap can OpenMapKit bring an added value to your data collection. While it is possible to keep the data on your POSM server without ever linking it with OSM one would wonder why for such a workflow you would choose OpenMapKit in the first place especially as the *.osm format is not very useful outside the OSM environment and ODK Collect could allow you to collect even more complex geometries. Hence, it is a tool that is useful only in this well-defined context.

An advantage of the POSM server is however that you can go entirely offline. You can have the portable OSM server without requiring an internet connection during the entire data collection. Only once the data needs to be uploaded to OSM, will the POSM server need to be connected to the internet.



III.5. Survey123 for ArcGIS

Survey123 for ArcGIS is an MDC tool with the application being very similar to well-known alternatives such as Kobo Toolbox. The main difference however is that data is stored in a ArcGIS feature service allowing easy integration with other tools of the GIS toolbox.



The tool has recently (in June 2016) left the BETA stage and is now a fully grown ESRI product. Nevertheless, the tools functionality still improves and certain features are still under development. New minor releases are currently launched every other month.

Current Version	Survey123 for ArcGIS v. 1.8
Platform	Android, Windows, iOS
Website & Forum	Main site: https://survey123.arcgis.com Blog: https://geonet.esri.com/groups/survey123/blog
Provider	ESRI
Requirements	ArcGIS Online or Portal 10.3.1. or higher
Pricing	No additional charge but ArcGIS Online account pricing (one account per max. 3 enumerators)
Components	App + Server(public or private)
Main strengths	- based on Xforms but stored in geographic database - automatic sync
Main weaknesses	- dependency on ESRI/ArcGIS - no Polygons/Lines or Tracking - if used with Online: account per enumerator - pricing
Standard Use Case	Creating a survey with complex logic that can be integrated into and managed through an existing ArcGIS architecture

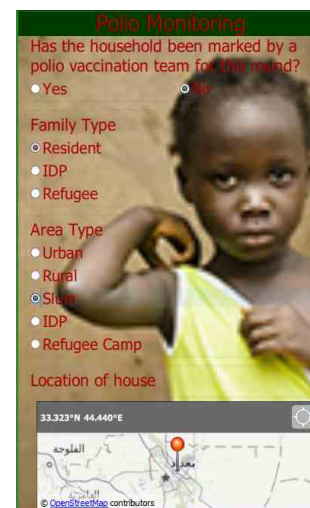
III.5.A. General Workflow

The form is created using a desktop or web-based interface, the desktop interface "Survey123 Connect" being the more flexible one that allows the creation of surveys in Excel by using XLS-form standards. Most common form features such as skip logic, cascading choices etc. are supported by the tool. Once created the form is uploaded to ArcGIS Online or Portal. In the publishing process two files are created one containing the form and one an ESRI feature service where the answers will be stored.

The form is shared in ArcGIS Online or Portal with a group of people all having an ArcGIS Online account. It is not possible to publicly share a survey and allow anonymous submissions. It is furthermore not possible to use a public account which means that each enumerator needs to be part of an ArcGIS Online organization (although it can be various organizations filling in one survey together). The designated enumerators can download the app and form to their phones. They can then answer the questions online or offline. It is not possible to edit existing data. Every change made to a survey once uploaded will be saved as a different survey.

The app's interface is quite easy to use and very similar to the one available by other MDC tools with some more options to personalize the survey layout e.g. by adding a background-picture, changing color and other layout options.

The answers are stored on the device in an SQLite database and can be uploaded automatically to the feature service once back online. While it is also possible to export the data from the phone manually, the upload process would be quite complex and time consuming. Currently, there doesn't seem to be a script which directly imports or converts the data into a feature service/csv or else. Once uploaded the data is available through the feature service which could be used in web mapping applications. In addition, through the <http://survey123.arcgis.com/surveys> page there are some statistics and charts available for the different questions to analyze results.



III.5.B. Geographic Dimension

Compared to other ESRI tools, geographic features play an inferior role in Survey123. Geopoint questions are just one of the question types available and it is possible to create forms entirely without geo-referencing (although the data will still be stored in a geographic feature service). More complex geometries such as line or polygon features are not (yet) supported and as in other MDC tools each table can only contain one geopoint question. A useful feature is the option to use location averaging for improved location accuracy: collecting several GPS locations over a timespan and then use the average over these locations as the reported geopoint.

In order to answer geopoint questions the current GPS position can be used directly. In addition it is also possible to choose a location directly on the map. To have this option available in offline collection the map tiles need to be downloaded to the phone. The process of downloading tiles to the phone is currently still relatively complex but should be simplified in future versions of the tool.

III.5.C. Security

Survey123 provides some security features but is nevertheless not a tool to be used for very sensitive information. Since the app provides no option to encrypt the collected data an encryption at phone level should be considered if used for sensitive information. In addition, collection of sensitive data should only be done if Survey123 is used with an instance of Portal for ArcGIS instead of ArcGIS Online ensuring that the firewall and settings of the server correspond to the security needs of the survey.

III.5.D. User experience and testing

Survey123 has a few features that other survey tools don't provide. The most useful one for the person creating the survey certainly is Survey123 Connect. The desktop interface allows the creation of XLS forms giving direct feedback on problems in the logic. This makes the creation of the surveys simpler for inexperienced users than in KoBo or other alternatives where the form needs to be uploaded in order to get feedback and validation.

Testing survey123 and its interoperability with forms created using other tools, it was surprising to see that some features were not supported. For example a cross-reference in the label section is not possible (such as using the name given in a previous question as a reference in the next section). In addition, in the application it seemed that some calculations needed time. For example, the questionnaire screen needed to be refreshed in order to be able to get into the repeat loop that was based on a previous question. Those were issues we did not encounter when working with ODK for example.

Last but not least a clear disadvantage is that is not possible to get the XML form directly from the server or to directly import an XML form without going through Survey123 Connect. This is something that makes debugging or collaboration on the form creation as well as integration of forms from other tools much more difficult.

III.5.E. Conclusion

Survey123 shows most features that we know from mobile data collection tools such as Kobo Toolbox or ODK using also the same standard (XLS-form standards) to create surveys but without yet providing the added value of better GIS data collection (e.g. collecting lines or polygons). The main difference to those MDC tools is the easy integration with other ESRI tools by storing the data in an ESRI feature service. This can be seen as an advantage but also as its main drawback since the ESRI dependence makes the tool expensive when used with ArcGIS Online and several accounts are needed.

Compared to other ESRI tools or GIS Data collection applications it brings the added value of complex form logic allowing cascading select questions, skip logic and more which we won't find many of the tools presented hereunder.

Bearing these points in mind it seems that the main selling point of Survey123 currently is to open the world of MDC to GIS technicians that are not necessarily familiar with tools like ODK or Kobo and hence enjoy a tool that provides additional functionality and easily integrates with an existing ESRI/ArcGIS architecture.

type	name	label	label:عربي
select_one governorate	governorate	Name of Governorate	محافظة
select_one district	district	Name of District	محافظة
text	healthfacility	Name of Primary Health Center	مركز صحي
select_one numberkids	numberkids	How many children under 5 live in the household?	خمس في المنزل
note	noteNoKids	<center><i>End of survey</i></center>	الان
begin repeat	child_repeat	<center>Child Questions</center>	سؤال
select_one age	age	What is the age of the child?	كم عمر الطفل
select_one male_femal	sex	What is the gender of the child?	ذكر (م) / أنثى (م)
select_one yes_no	fingerprint	Is the child's finger marked to indicate vaccination?	هل تم وضع علامة على إصبع الطفل
select_one yes_no	vaccinated	Is the child vaccinated with polio drops?	هل تم تطعيم الطفل
select_one yes_no	caregiverreceiveddrops	Did any caregiver ever visit your household to give polio drops?	هل زار أحد مقدمي الرعاية منزلك لتلقيح طفلك
select_one reason	reason	Why did the child not participate in the vaccination?	لماذا لم يلقح الطفل
text	reasonother	Please specify the reason	الرجاء تحديد السبب
select_one wherewaschild	wherewaschild	Where was the child?	كان الطفل
text	wherewasother	Please specify where the child was	حيث تم تحديد ابن كان الطفل
select_one location	location	Where the child got vaccinated?	أين تم تلقيح الطفل
text	locationother	Please specify the location of the vaccination	الرجاء تحديد مكان التلقيح
select_one yes_no	hascard	Does the caretaker have a vaccination card?	هل لدى مقدم الرعاية بطاقة التطعيم
select_one yes_no	OPVhistoryrecorded	Is polio vaccine (OPV) history recorded?	هل تم تسجيل تاريخ التطعيم
select_one yes_no	receiveddropsever	Has this child ever received a vaccination?	هل تلقى هذا الطفل التطعيم
end repeat			
begin group	FinalQuestions	<center>Final Questions</center>	أسئلة نهائية
select_one yes_no	haveyouheard	Did you know about the campaign prior to this survey?	هل كنت تعلم عن الحملة قبل هذا المسح
select_multiple fromwh	fromwhere	From which information sources did you hear about the campaign?	من المصادر التي سمعت عن الحملة
text	fromwhereother	Please specify	الرجاء تحديد

Polio Monitoring

How many children under 5 live in the household?

 2

Child Questions

 1 of 2

What is the age of the child?

 One to Two years old

☐ Less than a year

☒ One to Two years old

☐ Two to Three years old

☐ Three to Four years old

☐ Four to less than Five years old

What is the gender of the child?

Is the child's finger marked to indicate polio vaccination?

Survey123 for ArcGIS

 My Surveys

 Help

CartONG's Surveys

 + Create New Survey

0 Records

 Survey 1

 Data

5 Records

 Test1 Survey

IV. Category C – Map-first applications

This category contains tools that use a GIS-type approach⁸ to mobile data collection where data is stored in layers based on common attributes or geometry. While we have only one application that is presented in this category, this doesn't mean that there are no other applications which could fit this category.

In fact one other applications, NextGIS mobile app was tested as well but didn't prove interesting enough to discuss further. NextGIS is a free web-GIS similar to ArcGIS Online which also provides a mobile application. Although the NextGIS application has quite interesting features as it allows to create point, polygon or line layers directly on the phone, to add and update those layers, to export them as kml or directly link them with the online interface, the application also has a serious number of bugs which make it difficult to use the application: points are misrepresented, the synchronization, although set to true, will not happen, several crashes occurred during the testing and support is mostly available in Russian.

Hence for now only the application Collector for ArcGIS proved worth to detail further.

IV.1. Collector for ArcGIS

Collector for ArcGIS is an application allowing to update feature layers through a mobile device. It is not a survey tool and hence does not provide complex questionnaires but allows updating the attribute table of a layer as would be possible through ArcGIS Desktop.



Current Version	Collector for ArcGIS v. 10.3.7
Platform	Android, Windows, iOS
Website & Forum	Main site: http://www.esri.com/products/collector-for-arcgis Forum: https://geonet.esri.com/community/gis/applications/collector-for-arcgis

⁸ By this we mean that data is stored in layers such as in any standard GIS desktop software

Provider	ESRI
Requirements	ArcGIS Desktop, ArcGIS Online or Portal 10.3.1. or higher
Pricing	No additional charge but ArcGIS Online account pricing (one account per enumerator)
Components	App + Server (public or private) + Database Server
Main strengths	<ul style="list-style-type: none"> - update of existing data - adding points, polygons, lines - automatic sync with DB
Main weaknesses	<ul style="list-style-type: none"> - dependency on ESRI/ArcGIS - NO complex form logic/ Xform - if used with AGOL: account per enumerator - pricing - not ideal if a long list of features is available
Standard Use Case	Collecting and updating geographic data and attribute table information using a mobile device

IV.1.A. General Workflow

Collector for ArcGIS is the front-end application that needs to be connected to a backend server or ArcGIS Online/Portal which can be directly synced with a geographic database. The general workflow consists of four steps:

1. Layer creation and publishing
2. Webmap creation and sharing
3. Data collection/edition
4. Data synchronization and public sharing

First of all the layer(s) used for data collection need to be created in ArcGIS Desktop either in a gdb or a database engine. When creating those layers thought needs to be put into the domains which translate into drop-down options in the application and simplify data entry. It is possible to integrate existing data already at that point which can then be updated by the enumerators in the field. Once those layers are created an mxd containing an easy to use symbology should be created and published either directly to ArcGIS Online/Portal or to ArcGIS Server.

In a second step a webmap containing those layers is created in either ArcGIS Online or Portal. This webmap is shared with a group in ArcGIS Online/Portal. Members of that group can act as enumerators.

The enumerators, each having their own account, can download the webmap to their mobile phones. When collecting data offline, using a custom basemap (e.g. a recent satellite image), the basemap should be added manually to the phone (as a *.tpk). During the data collection the map serves as main entry point. Data can be added by either using the current location or by tapping on the map. Once the location is selected the attribute table information can be filled-in/updated. It is possible to have some fields marked as being required (if set as non-nullable in desktop) and see drop-down options if a domain was specified for a field. However there is no option to have more complex logic such as repeats, or grouping questions.

When collecting, the data is stored in a runtime geodatabase on the phone containing all the points (even those that were not updated). Once (back) online, the device and server database can be synchronized based on the timestamp value of each feature ensuring that changes made in each of those two databases is reflected in the other one. It is also possible to extract the data from the mobile phone manually and integrate it into the global database using ArcGIS Desktop (other tools won't be able to read the runtime geodatabase) where the timestamps can be compared manually to verify which features have been edited.

The features services used for editing are ideally only shared with the enumerators (in order to avoid updates by unauthorized users). Hence in order to make results visible to other users or use the layers in web mapping applications another service might need to be created.

IV.1.B. Geographic Dimension

As mentioned before the idea of Collector for ArcGIS is to enable the users to update their GIS layers in the field, hence it provides a larger set of options to work with complex geometries. It is possible to collect point, line or polygon features with the application and to update the geometry if necessary. It is possible to download basemaps for offline use: either existing ESRI basemaps but also custom basemaps such as recent satellite imagery. In addition, geographic information can be updated at any time.

IV.1.C. Security

If set up with ArcGIS Server or Portal to publish the layers, data collected with Collector can be well secured depending on the server's Firewall settings. What cannot be secured further is the data on the phone. It would hence only be possible to encrypt the device entirely if need be.

IV.1.D. User experience and testing

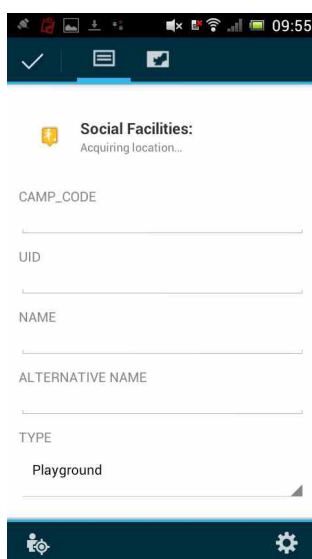
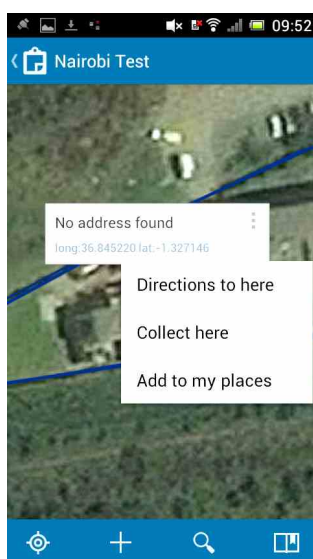
Collector for ArcGIS is currently used as tool for standardized camp mapping in UNHCR. This allowed testing the tool and workflow directly in the field. These collections pointed out the added value and drawbacks of the tool. Clearly the bottleneck (under field conditions) is the synchronization for which a WiFi or 3G connection is needed. If this is not available it is possible to extract the data manually from the phones but it is not possible to get the changes done in the database to the phones allowing for further edit of those. This means that good organization is required in order to avoid different people collection the same points several times. Furthermore, Collector is clearly a tool that is relatively heavy to set up having the layers to prepare in a way that they don't require further changes at a later stage, a symbology that is easy to use on the small screen of a phone, the correct user rights and editor tracking enabled to ensure synchronization can happen. This means that a GIS expert always needs to be involved in the process of preparing a data collection with Collector.

Nevertheless the app brings a great added value with its ability to update information and the actual application is very user friendly making it easy to train enumerators for the collection.

IV.1.E. Conclusion

Collector for ArcGIS is one of the few tools which allows collecting and updating any geographic layer offline, this is a great asset especially for monitoring tasks. Furthermore it's capability to work not only with points but also line or polygon features can make it an invaluable tool.

Nevertheless the tool also has a few down-sides. Being a map-centric product it is clearly not designed to support any questionnaire with complex logic. In addition, the collection of data in the field needs some thorough preparation to have a synchronization between the different components: phone app, server and database. Therefore the tool only brings an added value for large standardized data collection efforts. For short, unstandardized collections, other tools should be considered. Last but not least, being an ESRI product it is probably only worth investing in the tool if an ArcGIS architecture is already set up.


































































V. Conclusion

The comparison of MDC applications with strong GIS component shows that there is not one application that could fit all situations and needs. Hence when selecting an application the following should be considered:

- Is the tool needed for a coordinated (standardized between different collectors) or uncoordinated data collection?
- Which servers are available/already in use or is there enough time for a new server setup?
- Does the focus lie on the form features (you need skip logic, cascading select questions etc) or on the geographic information?
- Is it acceptable to have the output only in a geographic database or rather as excel table?
- Should the data be integrated into OpenStreetMap?

Unfortunately, there will not be an application fitting each specific combination of needs and requirements. For example, none of the apps presented above will allow customized data collection and complex form logic without any server instance set up. An overview of which application is helpful in which context is given in the table below:

	Assessment type  uncoordinated  coordinated	Form logic  OSM tags only  Simple custom  Complex custom	Geometry  Points only  Points & Tracking  Points, Line, Polygon	Server required  No  Yes	Output formats  Geo-type only  CSV-type  Geo and CSV	Integration with OSM  none  possible
Maps.Me					 KML	
OsmAnd					 GPX	
ODK				 (ODK/KoBo)	 CSV (but KML for Point)	
GeoDataCollect				 (ODK/KoBo)	 GPX	
GeoODK				 (ODK/KoBo)	 CSV (KML for Point)	
OpenMapKit			 (but attributes for Polygons possible)	 (POSM)	 CSV and .OSM	
Survey123				 (ArcGIS)	 CSV and GDB	
Collector for ArcGIS				 (ArcGIS)	 CSV and GDB	

VI. Annex

This annex contrasts the app of the different categories again in table format giving the information more briefly but in some parts also more detailed than in the text above.

VI.1. Overview: Simple map-centered applications

This table includes as well OSM Tracker for Android and GeoPaparazzi – two tools which were not considered for the full benchmarking but that still provide interesting features (GeoPaparazzi) or are well known by the community (OSM Tracker for Android).

	Maps.Me	OsmAnd	OSM Tracker *for Android	GeoPaparazzi
GENERAL				
URL/ Link	http://maps.me/en/home	http://osmand.net/	https://github.com/nguillaumin/osmtracker-android/wiki	http://geopaparazzi.github.io/
App Type	Simple Map-centered applications	Simple Map-centered applications	Simple Map-centered applications	
Main purpose/ Best use case	Offline map and routing, including functionality to edit OSM data	Offline map and routing, including functionality to edit OSM data (through a plugin)	Track waypoints using mobile phone for easy update of OSM data	Record private georeferenced data including text notes, images, map screenshots
Provider; Firm, Business Model	Bought by Mail.Ru (Moscow) to be integrated with My.com	Open development on github	Open development on github	
Source code open	Yes, on github	Yes, on github	https://github.com/nguillaumin/osmtracker-android	Yes
Prerequisites	OSM account for editing	OSM account for editing	OSM account for editing	"GPS Status and Toolbox" app
Pricing	free of charge	Free: max 10 map downloads 6.99€: unlimited downloads	Free	Free but "GPS Status and toolbox" costs 3.69€ or adds
Required accounts	OSM account for editing of map features	To update OSM data, an OSM account it required	OSM account	None
Main strengths	- direct synchronization with OSM - offline routing - OSM data offline free of charge	- In advanced editing mode, OSM tags can be used for edits making the app very flexible	- offline OSM data collection for easy integration - offline tracking	- only app without server setup that allows custom data collection
Main weaknesses	- no custom data collection and data model - for public/OSM information only	- no editing of position possible - no data collection for personal data	- overwhelming interface - OSM knowledge required	- no simple upload to OSM - requires other app for GPS receiver
Platforms	Android, iOS, Blackberry OS	Android, iOS	Android ⁹	Android
FORM CREATION				
X-form standard	X	X	X	X (JSON for customized form)
Form Creation Interface	X	X	X	X
Details	OSM model is used there is no custom form creation	OSM model is used there is no custom form creation	OSM model is used there is no custom form creation	You can create a json file including various tags
FORM FEATURES				
Custom attribute data collection	X (only following OSM model)	X (only following OSM model)	X (only OSM model)	V
Simple features (required fields, ð)	X	X	X	V
Complex features (skip,	X	X	X	X

⁹ There is an OSM Tracker for Windows which is not part of the same development. This tracker was discontinued.

		Maps.Me	OsmAnd	OSM Tracker *for Android	GeoPaparazzi
Media types	repeat, ð)				
	Image	✗	✓ (plugin)	✓	✓
	Audio	✗	✓ (plugin)	✓ (voice recording)	✗
	Video	✗	✓ (plugin)	✗	✗
Geometries	Barcode	✗	✗	✗	✗
	Point	✓	✓	✓	✓
	Line	✗	✓	✓	✓
Location	Polygon	✗	✗	✗	✗
	Tracking	✗	✓ (plugin trip recording)	✓	✓
	Elevation	✗		✓	✓
	GPS accuracy visible	✗	✗	✓	✗ (visible in "GPS Status and Toolbox")
Multi-language support	Input validation	✗	✗	✗	✗
	Several alphabets	✓ over 20 languages depends on OS settings. When phone language changes features names changes as well	✓ approx. 20 languages	✓ over 60 languages depends on OS settings. When phone language changes features names change as well	✗ only one language per json form. App uses icons – very little language
	Switch within app/form	✗ Not within form but can be done any time	✗ it's possible to switch map language without switching application language (Aeroport-Airport,...) but need reopening	✗ Not within form but can be done any time	✗
Form layout/ usability (for enumerator)		simple: self-explanatory, not many options	medium: interface and map rendering overwhelming	difficult: not self-explanatory - OSM knowledge required, no visibility of map while tracking	simple: self-explanatory, not many options
Offline features	Offline editing	✓	✓	✓	✓
	Offline basemap	✓, OSM data directly downloaded to phone when zooming to area	✓, OSM only, otherwise only cached tiles	✓, can be done but not visible while tracking	✓
	Bing Maps	✗	✓, through "online maps" plugin	✗	.
Available basemaps	OSM	✓	✓	✓: Mapnik, Cycle	.
	ArcGIS (various)	✗	✗	✗	✗
	Custom	✗		✗	✓ (mbtiles)
	Google	✗	✗	✗	✗
Data import (e.g. from CSV, gdb,...)	Feature import	✓ OSM features	✓ OSM features	✗	
	Data import (e.g. from CSV, gdb,...)	✓ as kml	✓ as gpx or obf	✗	
DEVICE STORAGE					
ge form	Encryption possible	✗	✗	✗	✗
	Manuel export/import	✓	✓		✓
	GPX	✗	✓	✓	✓
	other open/ public	✓ KML, KMZ for bookmarks	✗	✓ SQLite possible	✓ KML, SQLite

	Maps.Me	OsmAnd	OSM Tracker *for Android	GeoPaparazzi
proprietary	X	✓ obf	X	X
SYNCHRONIZATION AND INTEGRATION				
Integration with OSM	✓ directly integrated	✓ directly integrated	✓ directly integrated	X
Near-Realtime sync/update for OSM data	X changes made to OSM only visible in next release for other phones	X new features visible approx. after one month, except for subscription-based "OSM Live" which enabled hourly updates	X	X
SUPPORT				
under active development	✓	✓ osm community	X nothing new since 1 year	.
Business support	X	X	X	.
Active user community		✓ osm community		.
Main blog/forum to find answers/help		- http://forum.openstreetmap.org http://wiki.openstreetmap.org/wiki/Main_Page	http://learnosm.org/files/OSMTracker_en.pdf	.

VI.2. Overview: advanced map and survey-centered applications

	ODK Collect	GeoDataCollect	GeoODK	OpenMapKit	Survey123 for ArcGIS
GENERAL					
URL/ Link	https://opendatakit.org/use/collect/	http://wiki.openstreetmap.org/wiki/GeoData_Collect	http://geoodk.com/	http://openmapkit.org/	http://survey123.arcgis.com/surveys
Main purpose/ Best use case	Fill in ODK form including geoshape and geotrace questions	Track your location while filling in ODK-like form	Fill in ODK-like form including geoshape and geotrace questions	Filling in an ODK survey in the field, including questions which will update and add information to be made available in OSM.	Creating a survey with complex logic that can be integrated into and managed through an existing ArcGIS architecture
Provider; Firm, Business Model	Open-source project with various participants	HOT Indonesia	Developed by University of Maryland	Developed by American Red Cross	ESRI
Source code open	Yes available on github	Yes, github + based on two open-source projects OSM Tracker + ODK	Yes, available on github	Yes, available on github	Yes, available on github
Prerequisites	Server: KoBo, ODK or else	Server: KoBo, ODK or else	Server: KoBo, ODK or else	ODK Collect on phone and a POSM server instance (cloud or local)	ArcGIS Online or Portal 10.3.1 or higher
Pricing	Free	Free	Free	Free but cost of server	no additional pricing if used with Portal, if used with Online depends on user accounts
Required accounts	depending on server: KoBo, ODK or else	depending on server: KoBo, ODK or else	depending on server: KoBo, ODK or else		max 3 enumerators can share one account (AGOL Organization) but not ideal
Main strengths	- complex form logic - tracking available	- direct link with OSM - simple tracking	- complex form logic - tracking available - overview map of all collected geodata	- update of existing geo-data - automatic sync with POSM server - very easy integration with OSM	- based on Xforms but stored in geographic database - automatic sync
Main weaknesses	- no editing of features once sent to the server	- no automatic link between track and form	- integration of the geo-type questions into GIS tools requires several steps	- No polygon/line drawing - server maintenance, debugging up to client - not intended for collection of Non-OSM geo-data	- dependency on ESRI/ArcGIS + pricing - no Polygons/Lines or Tracking - no editing of features
Platforms	Android	Android	Android	Android	Android, iOS, Windows
FORM CREATION					
X-form standard	✓	✓ for form but not for geo-features	✓	✓ including “OSM” type question	✓ including
Form Creation Interface	Possible to use Excel	Similar to ODK	Similar to ODK	Similar to ODK	✓ “Survey123 Connect” for Desktop or for simpler forms “online
Details	Create standard X form including geotrace and geoshape questions				
FORM FEATURES					
Custom attribute data collection	✓	✓	✓	✓ if linked to ODK	✓
Simple features (required fields, ð)	✓	✓ like ODK	✓ like ODK	✓ like ODK	✓
Complex features (skip, repeat, ð)	✓	✓ like ODK	✓ like ODK	✓ like ODK	✓

Media types	Image	✓	✓ like ODK	✓ like ODK	✓ like ODK	✓
	Audio	✓	✓ like ODK	✓ like ODK	✓ like ODK	✓
	Video	✗	✗	✗	✗	✗
	Barcode	✓	✓	✓	like ODK	✓
Geometries	Point	✓	✓	✓	✓	✓
	Line	✓ geotrace	✗	✓	✗	✗
	Polygon	✓ geotrace, geoshape	✗	✓	✗	✗
Location	Tracking	✓	✓	✓	✗	✗
	Elevation	✓	✓	✓	✗	✓ esriFieldTypePointZ
	GPS accuracy visible	✗	✓	✗	✗	✗
	Input validation	✓	✓ like ODK	✓ like ODK	✓ like ODK	✓
Multi-language support	Several alphabets	✓	✓ like ODK	✓ like ODK	✓ like ODK	✓
	Switch within app/form	✓ depends on form labels	✓ like ODK	✓ like ODK	✓ like ODK	✓
	Form layout/ usability (for enumerator)	Simple: easy to use not many options	Middle: confusing since a link between form and tracking is expected	Simple: easy to use not many options	Simple: for the application but more complexity at server level	Simple: Clear structure, most features are self-explanatory
Offline features	Offline editing	✓	✓	✓	✓	✓
	Offline basemap	✓ but only through caching	✓ but only through caching	✓	✓	✓
	Bing Maps	✗	✗	✗	✗	✗
Available basemaps	OSM	✓	✓	✗	✓	✓
	ArcGIS (various)	✗	✗	✓	✗	✓
	Custom	✗	✓ (mbTiles but not visible while tracking)	✓ mbTiles	✓ mbTiles	✗
Pre-existing features (e.g. OSM)	Google	✓	✗	✓ Satellite, Street	✗	✗
	Pre-existing features (e.g. OSM)	✓	✗	✗	✓ from OSM	✗
Data import (e.g. from CSV, gdb,...)		✓	✗	✗	✓ from OSM	✓ from CSV new function pulldata()
DEVICE STORAGE						
Encryption possible		✗	✗	✗	✗	✗
Manuel export/import		✗ only XML format – not useful but possible	✗ only XML format – not useful but possible	✗ only XML format – not useful but possible	✗ only .osm format	✗
Storage formats	GPX	✗	✓	✗	✗	✗
	other open/ public	✓ XML for all questions, human readable but can't be directly imported into any	✓ XML for all questions, human readable but can't be directly imported into any	✓ XML for all questions, human readable but can't be directly imported into any	✓ XML for all questions, human readable but can't be directly imported into any	✓ SQLite for answers but not ideal to work with outside the app

		GIS software	GIS software	GIS software	GIS software	
proprietary		X	X	X	X	X
DATA TRANSFER						
Transfer using HTTPS		✓ depends on server	✓ depends on server	✓ depends on server	X depends on server setup	✓ depends on server
Manual transfer possible		X	✓ of tracks through JOSM X for forms	X	✓ through JOSM	
Details						
MAIN STORAGE						
Database storage		X	X	X	X	X
Cloud storage		✓	✓	✓	✓ POSM in cloud	✓
Private server		✓	✓	✓	✓ POSM local	✓ (if used with Portal)
SHARING						
Export/ Sharing format	JSON/GeoJSON	X	X	X	✓ of form data only	✓ via AGOL
	CSV	Depends on server: yes if ODK but no if KoBo,...	Depends on server	Depends on server	✓ of form data only	✓ via AGOL
	Other	Depends on server: KoBo download as xls form available	Depends on server	Depends on server	✓ *.osm of osm data	✓ via AGOL: gdb, shp
	REST API	Depends on server: KoBo API available	Depends on server	Depends on server	X	✓ via AGOL
	Integration with OSM	X	✓ possible to upload tracks	X	✓ from server to osm	
Near-Realtime sync/update for OSM data		X	X	X	✓ but not visible on other phones unless new "atlas" created	
SUPPORT						
under active development		✓ latest release end of November 16	X no updates since February 2016	?	✓	✓
Business support		X	X	X	X	✓
Active user community			OSM community, if any	?		
Main blog/forum to find answers/help			OSM wiki			GeoNet