2.3 Selecting Hardware

Hardware encompasses all physical assets related to technology, computers, and electronics needed for a project. When designing a mapping project, managers will need to assess what hardware, and specifications, are necessary to complete the work. While the anticipated project workflow influences the selection of hardware, it is important to note that the availability of technology and resources for procurement may place restrictions on hardware selection. In this way, hardware availability can also influence the workflow, making hardware selection an important part of the planning process. Questions to ask during hardware selection:

- Will mappers be collecting data in the field? If yes, see Mobile Data Collection: smartphones & tablets to determine what devices are best for field data collection.
- Will mappers be collecting data for more than: 4 hours a day with OpenMapKit and/or navigation/tracking apps? 6 hours with OpenDataKit or KoboCollect? If yes, see Powerbanks and charging.
- Will data need to be stored or backed up physically? see Storage Devices: POSM & Hard Drives
- Will there be digitization and editing of data? Will maps and visualizations need to be made from data? See Computers to understand what specifications are needed for different activities.
- Will there need to be drone imagery capture? see Drones and UAVs to understand what machines are best suited depending on the need.

- Will there need to be street view imagery capture? see Street view imagery: phones, cameras, and 360 devices.

Mobile data collection: smartphones & tablets

Smartphones versus tablets When choosing a type of device for mobile data collection, it is important to determine if a smartphone or tablet is more appropriate for mapping activities. Each device types have pros and cons, so it's important to understand what is best for a particular project, mapper, and environment.

When planning to use OpenDataKit:

Most any Android smartphone or tablet will do, as long as it has a relatively modern Android version (4.1+).

When planning to use OpenMapKit:

To enable OpenMapKit to run fluently and be able to handle larger background maps (in 'mbtiles' format) and OSM data, please make sure that phones have:

- At least 1.5, but preferably 2 GB of RAM
- Preferably 16 GB of storage
- A modern Android version (6.0+)

Furthermore, the following are recommended:

- A 5" screen for usability
- A decently sized battery. For extended usage, it may be necessary to have battery packs
- Make sure to have enough charging options, such as car chargers and extension cords

The following phones/models have been verified to work well on various projects:

Smartphones:

- Tecno Camon C9 (2 GB RAM)
- Tecno L9 (2 GB RAM, 16 GB storage)
- Huawei Y5 (2017) and Huawei Y6 Pro (2 GB RAM, 16 GB storage)
- Sony Experia L1 (2 GB RAM, 16 GB storage)
- Motorola Moto G5 (2 GB RAM, 16 GB storage)
- Infinix

Tablets:

- Samsung Tab A (SM-T285, 7", 2016) (1.5 GB RAM, 8GB storage)
- Huawei Mediapad t3 10 AGS-W09

Protecting mobile devices HOT recommends that cases are procured for all mobile data collection devices, regardless of type. This will help protect the devices from weather, dropping, sun exposure, and other hazards. Ultimately, protecting devices not only reduces costs associated with device loss or replacement, it also protects the loss of data stored in the devices.

Power banks and charging

When using mobile devices for data collection, ensuring that devices can remain charged throughout the day and be recharged is critical. HOT recommends procuring power banks when possible to ensure that devices are ready for mapping. Each project (and applications used) will have different drain on mobile devices, in general, HOT has found that consistently collecting surveys with OpenMapKit and running a GPS application in the background (i.e. OSMAnd, OSMTracker) will drain a typical device battery in 3-5 hours - requiring the need for power banks to work through the entire day. When selecting power banks, it is recommended that they are tested for compatibility with the mobile device used.

In addition to keeping devices charged during the day, project managers need to consider how all devices (including power banks) will be charged at the end of the work day. Will mappers have access to power at night? Does your team have enough outlets or power strips to effectively charge all of your devices? Will mappers need to find alternative options for charging devices?

Storage Devices: POSM & Hard Drives

When collecting survey data in the field, accidents can happen including lost, damaged, or stolen mobile data collection devices or laptops. For that reason, it is important to have a data storage strategy to ensure back-ups exist. It is much easier to recollect one day's worth of field data than to completely redo all of the work. Multiple laptops with duplicate back-ups, hard drives, or using a POSM are all effective ways of keeping back ups, even if your team is using a cloud server. Storage devices should have at minimum 1 terabyte of storage.

Street view imagery: phones, cameras, and 360 devices

Mapillary provides an up-to-date list of recommended equipment for capturing street view imagery at: https://help.mapillary.com/hc/en-us/articles/115001478065-Equipment-for-capturing-and-example-imagery. In addition to recommended devices, this list provides additional equipment recommendations including mounts, memor cards, charging, and cases. Additionally, HOT has used mobile devices provided in the OpenMapKit list above for street view imagery capture.

Computers

Determining the specifications, quality, and type of computer depends on the needs of the project or activity. At minimum, computers involved with mapping activities should have the following specifications:

- 15" screen or larger
- Processor: Core i5, relatively new
- RAM: preferably at least 8gb
- 512 GB hard disk or larger
- Operating system: Windows or Linux preferred for most applications

The following computers have been verified to work well on various projects, categorized by typical use:

a) Training, data cleaning and basic GIS/data processing

- Lenovo Ideapad 320
- HP 250 G6
- Lenovo ThinkPad X234
- DELL Latitude E6430s
- HP Elitebook 840

b) Advanced GIS and drone imagery processing

- Acer Aspire e5-575
- Lenovo P50

Drones and UAVs

When quality imagery is not available or up-to-date imagery is necessary for a data collection process, such as capturing the impact of a recent flood or to capture newly constructed buildings, using a drone or unmanned aerial vehicles (UAVs) may fulfill imagery needs. Selecting a UAV/drone depends on the need of the project and available resources. Drones/UAVs are generally classified into three types based on mode of flight. See the table below for a compariison of the different types. *Note: cost is based on HOT experience and is not necessarily representative.*

Type	Flight time	Max speed	Payload	Coverage	Cost range
Multi-rotor UAV	25-45 minutes	45-60 mph	450g-5.5kg	2-7 km2	$3-65k
Fixed Wing UAV	45 minutes	40-110 mph	1-3 kg	<12 km2	$25-120k
Hybrid UAV	60 minutes	70-120 mph	1-6 kg	<13 km2	$30k+

In brief, multi-rotor UAVs are best suited for small-scale operations with smaller mapping areas and/or quick response time for flight deployment (i.e. responding to natural disasters), whereas fixed wing UAVs are better suited for aerial mapping of large areas.

For HOT projects, we have selected and used the following drones:

- Multi-rotor: DJI Phantom 4 Pro
- Fixed wing: senseFly eBee

Please note: anyone interested in drone flying should understand local drone/UAV laws and regulations, as well as seek out proper training in piloting.

Hardware Management Considerations

- Create and have all mapping participants sign an agreement for the responsibility and liability of devices
- Create an equipment sign out log