

1.3 Hardware Selection

Course Objectives

In this section, you will learn and find information on selecting the appropriate hardware to support the mapping project. By the end of this, you should be able to:

- Determining what hardware may or may not be needed
- Understand the minimum hardware specifications based on the project needs
- Understand additional document(s) that may be required to record the hardware

Learning Activities

Hardware Considerations

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. Below this is a hardware requirement based on the type of mapping activity:

	Remote Mapping	Field Mapping	Capture Latest Imagery	Capture Street View
PC/Laptop	☑	☑	☑	☑
Smartphones/tablets	☑	☑	☑	☑
Power bank	☑	☑ Optional (if you need to collect data > 4 hours/day)	☑	☑
External hard drives	☑	☑ Optional (if you need back-ups)	☑ Optional (if you collect a large number of drone images)	☑
Drones	☑	☑	☑	☑
Action camera/360° camera	☑	☑	☑	☑

Table 1. Hardware requirements based on specific mapping activity

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

- 14" screen or larger
- Processor: Core i5, with a relatively new CPU generation
- RAM: preferably at least 8GB (or 16GB if you need to run GIS/imagery processing)
- 512 GB hard disk or larger
- Operating system: Windows or Linux preferred for most applications

Smartphones & 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. Since most of the data collection will be run on the Android operating system, it is important to

ensure that the minimal Android operating system is version 5.0.1 (the minimal OS for running ODK Collect).

While currently there are a lot of smartphone manufacturers that offer different specifications, the following general requirements that HOT suggest to be able to run field data collection activity without worry are:

- A 5" (inch) screen size for usability
- At least 2GB of RAM
- Minimal 16GB of storage (might need larger storage if you heavily collect pictures/videos)
- A decent-sized battery. For extended usage (data collection > 4 hours/day), it may be necessary to have battery packs/power banks.

Tips:

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 but also protects against 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 a different drain on mobile devices, in general, HOT has found that consistently collecting surveys with ODK Collect 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.

Tips:

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. Consider the following questions:

External Hard Drive 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 backups 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 backups and hard drives are effective ways of keeping backups, even if your team is using a cloud server. Storage devices should have **at minimum 1 terabyte of storage**.

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 capturing 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 the mode of flight. See the table below for a comparison 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 km ²	\$3-65k
Fixed Wing UAV	45 minutes	40-110 mph	1-3 kg	<12 km ²	\$25-120k
Hybrid UAV	60 minutes	70-120 mph	1-6 kg	<13 km ²	\$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

Tips:

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

Hardware Management

As a project manager, one of your primary responsibilities is to ensure that your team has all the necessary equipment to complete their tasks. This includes survey equipment, which can be expensive and integral to the project's success. To avoid mismanagement of this equipment, creating a careful flow that tracks usage and responsibility is essential.

One way to accomplish this is to require all team members who obtain temporary survey equipment to sign an agreement outlining their responsibility and liability for the devices. This process ensures that everyone understands their role in maintaining the equipment's condition and preventing loss or damage.

In addition to the agreement, keeping a record of who is responsible for each piece of equipment at all times is also crucial. This helps to prevent misunderstandings or disputes and ensures that the equipment is always available when needed.

To assist with this process, there are numerous hardware management resources available. These include software solutions that can track equipment usage and maintenance, as well as physical resources like lockers or cabinets for secure storage. Utilizing these resources can streamline the equipment management process and ensure that your team has the tools they need to succeed. These are some examples of hardware management resources:

- Example equipment log
- Equipment sign-out log

[Quiz] Check Your Knowledge

You create a field project where you need to collect the latest information on the field. Upon preparing the base data in OSM, you realized that the imagery is unusable (blurry and outdated). In order to get the latest information, you need to collect the latest imagery before your field data collection begins. What equipment that you need to prepare during the planning process?

1. 360 camera, laptop, power banks
2. Laptop, smartphone, drone, power banks, and external drive
3. Action cam, paper form, name-tag, & laptop
4. Laptop

Answer: 2

Activity Checklist

By the end of this section, you should be able to perform the following: * Figure out which equipment and its specification you should consider for your mapping activity * Understand the importance of hardware management and sign-out log document to record your hardware movement