Evaluating Digital Workflows in Academic and CRM Settings

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Introduction

Digital workflows are an increasingly common component of archaeological fieldwork but are not ubiquitous. Digital recording methods offer a number of advantages for field archaeologists. In this poster, we examine options for digital recording equipment, setup, and workflows and assess efficacy in two different settings: Cultural Resource Management (CRM) fieldwork in the U.S. Southwest and academic dissertation fieldwork in leeward Kohala, Hawai'i Island.

Background

Digital Recording in Archaeology

Many CRM companies and academic research projects have utilized digital recording workflows[1-6]. This is not a comprehensive review. However, there are several key takeaways:

- Workflows use a range of devices: iPads, tablet PCs, smartphones etc.
- Smartphones, particularly newer models, can be capable GPS devices[2]
- If greater precision is required, there are a range of available consumer-grade GPS devices of varying accuracies[6]
- Recording apps vary from specific database apps (e.g. FileMaker Go, FileApp Pro) to custom apps built to suit a certain project [3, 4]
- Many encountered issues are environmental: glare, rain, device overheating[1]

Notable among these workflow descriptions is Ullah[6], who provides a detailed description of devices and methods. Ullah's proposed workflow, with an inexpensive tablets and a Bluetooth GPS, inspired part of the workflow we test here.

Digital Recording Hardware and Software

The first step in developing and evaluating a digital workflow is determining available options. Table 1 provides a summary of widely available and/or frequently used devices. These devices fall into a few different categories.

Device	Bad Elf GNSS Surveyor	Trimble Geo7X	Garmin GPSMAP 64sx	iPhone (14 Pro)	Pixel 4a	iPad (10th gen.)
Cost	$650	$8,000	$350	$999	$496	$449
Software	Avenza $145*	TerraSync (Included)	Garmin Connect/ Garmin Explore	Avenza $145*	Avenza $145*	Avenza $145
Extra Hardware	Tablet $160 - $1,000	*N/A*	Tablet $160 - $1,000	Bluetooth GPS (optional)	Bluetooth GPS (optional)	Bluetooth GPS
Total Cost	$955 - $1,795	$8,000	$510 - $1,350	$1,144	$641	~$1,100
Accuracy	~90 cm	~1 cm	5 – 10 m	Not reported	Not reported	No Internal

**Yearly subscription, 1-2 devices*

Table 1 Selected hardware and software available for digital recording workflows

The first is a standalone GPS receiver (Bad Elf GNSS Surveyor). Receivers like this can connect via Bluetooth to a smartphone or tablet and replace the device's internal GPS. The second category include high-accuracy GPS devices. In some cases, these devices allow for creation or import of custom data dictionaries (e.g. Trimble products) while others have standard attributes which fill in automatically. The final category are common consumer smartphones/tablets. Many have their own internal GPS which in some cases is comparable to a GPS unit.[2] With the internal GPS or with a Bluetooth GPS, these devices can also be used as all-in-one data collectors.

Methods and Workflow (CRM)

Vallejos tested this workflow across several CRM projects conducted in New Mexico.

Materials

GPS: Bad Elf GNSS Surveyor
Data collection: Lenovo Yoga Tab 3
Software: Avenza Maps Pro, Google Drive, Adobe Reader (app)
Other Devices: Canon Powershot ELPH 180

Pre-Field Workflow

1. Set up Avenza with GeoPDF basemaps of study area
2. Create a shared Drive folder for field data accessible by the crew chief/GIS specialist
3. Set up offline Drive photo log Google Sheets file

In-Field Workflow

1. All crewmembers flag artifacts, features, and find site boundaries
2. Crewmember 2 and 3: Use Lenovo tablet with pre-built Avenza Maps schema and Bad Elf to record all surface artifacts, points of interest, and map site boundary
3. Crewmember 1: Fill out a PDF fillable New Mexico Laboratory of Anthropology (LA) form, the state-specific archaeological site form, while consulting with other crewmembers
4. Crewmember 1: Take overview photos and photos of any features and artifacts of interest and fill out photo log

Post-Field Workflow

1. Photo log automatically syncs to Drive
2. Upload PDF LA forms manually to Drive
3. Manually export all Avenza data to NAD83 UTM Zone 13N shapefiles at the end of each workday for backup; only the last day's file will be used for final map creation

Fig. 1 In-field site recording (left), Bad ELF GNSS Surveyor in high visibility treeless environment (middle), and in a deep, forested gulch (right)

Limitations

- No available waterproof cases for Lenovo tablet – cannot work digitally in the rain
- Built-in camera insufficient for report-quality photos (additional device required)
- Profiles/plan-view maps must be drawn on paper (few vector drawing app options for this older device)
- Data must be manually synced at the end of the day

Methods and Workflow (Academic)

Peck tested this workflow for her dissertation fieldwork on the dry (leeward side) of Kohala, Hawai'i Island.

Materials

GPS: Bad Elf GNSS Surveyor
Data collection: Personal smartphone (Pixel 4a), research group iPads
Software: Avenza Maps Pro, Graphic, Adobe Reader (app), Google Sheets, Dropbox
Other Devices: Canon DSLR

Pre-Field Workflow

1. Set up Avenza with GeoPDF basemaps of study area, import custom schema
2. Create a shared Dropbox folder for field data accessible by crewmembers
3. Create separate Avenza layers for each field day

In-Field Workflow

1. All crewmembers flag artifacts
2. Crewmember 1: Assign site field number and fill out fillable site/feature PDF form (Adobe Reader on iPad)
3. Crewmember 2: GPS recording of surface artifacts/features (Pixel 4a with Bad Elf)
4. Crewmember 2/3: Site/selected artifact photography (Pixel 4a or separate camera with Google Sheets photo log on iPad or phone)

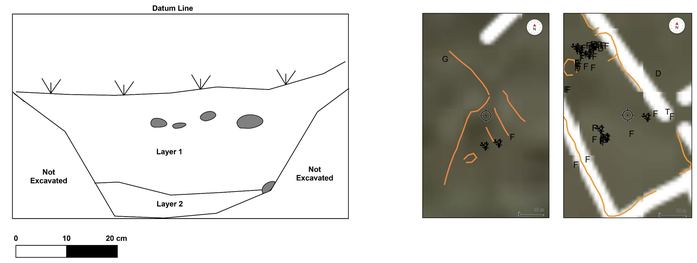

Fig. 2 Excavation profile (left) and Avenza field map screenshots (right), no post-field processing

Post-Field Workflow

1. Manually upload PDF forms to Dropbox
2. Google Sheets photo log automatically syncs with WiFi
3. Upload photos to Dropbox, divide by site
4. Export daily shapefile layer to Dropbox

Limitations

- GPS accuracy high in my study area – increased tree cover/different landforms may prevent GPS from taking good points elsewhere in Hawai'i (vector illustration programs offer digital compass-and-tape workaround)
- GPS/phone are resilient to rain, but the additional camera is not
- Recording artifacts on personal phone drains the battery

Discussion and Conclusion

From a CRM perspective, the digital recording offers a number of advantages. First, exported digital field forms are in near-finished condition, saving time and money on report preparation. In addition, handwriting and transcribing difficult handwriting is a non-issue. Second, digital recording systems are more accessible. As someone with dyslexia, Vallejos notes that digital forms allow him to dictate large sections of text. Digital forms can also integrate with screen reading technology. From an academic perspective, cost and speed are major benefits of this workflow. While Peck used previously-purchased lab equipment to supplement her digital recording workflow, the bulk of data collection (surface artifact documentation and field forms) could have been completed with the Bluetooth GPS and a personal mobile device. A device like the Bad Elf is feasible to purchase with a single grant. Further, quickly visualizing field data also facilitates creating community presentations during field sessions.

Future Directions

Future directions for this digital workflow will likely include upgrading digital recording devices. A major drawback of low-cost tablets is that they often run an older OS that cannot run the latest apps. We also hope to integrate more automated methods for GIS data and field note extraction, implementing open-source Python libraries.

References Cited: [1]Banning, E. B., and P. Hitchings. 2015. Digital archaeological survey: Using iPads in archaeological survey in Wadi Quseiba, northern Jordan. *The SAA Arch. Record* 15(4):31–37.; [2]Cascalheira, J., C. Goncalves, and N. Bicho. 2014. Smartphones and the use of customized apps in archaeological projects. *The SAA Arch. Record* 14(5):20–25.; [3]Fee, S. B., D. K. Pettegrew, and W. R. Caraher. 2013. Taking mobile computing to the field. *Near Eastern Archaeology* 76(1):50–55.; [4]Goodale, N., D. G. Bailey, T. Fondak, and A. Nauman. 2013. iTrowel: Mobile devices as transformative technology in archaeological field research. *The SAA Arch. Record* 13(3):18–22.; [5]Stewart, M. E., and L. L. Johnson. 2011. The excavation is the classroom. *SAA Arch. Record* 11(3):22–27.; [6]Ullah, I. I. 2017. A Mobile Data-Collection Workflow for Archaeologists. https://isaacullah.github.io/A-mobile-field-data-collection-workflow/

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