

Considerations for Digital Field Data Collection

by Scott Deaton and Katie Aguilar
Dataforensics



When investigating various digital data collection alternatives, both the hardware and software must be evaluated. Do the limitations of the hardware hinder the data collection process, or does the technology enhance the data collection process? Does the software improve the data collection process or is it simply a digital version of the existing procedure? This document summarizes considerations that engineers and geologists may want to consider when choosing a digital data collection system.

Hardware Considerations

- **How long will the batteries last?** The battery life is very important when doing fieldwork. The batteries should be sufficient to perform several days of fieldwork without having to recharge them. If a device is not operational because the batteries are dead, it is a productivity inhibitor. Also, if the batteries die and are not recharged within a limited period of time, data may be lost. This is a problem in particular with the Pocket PC devices. Palm™ devices that are equipped with rechargeable batteries avoid this problem with a backup battery that lasts about a week.



- **What type of screen should the device have?** If doing data collection outdoors, a monochrome screen is preferable. Color LCD screens are appealing, but they wash out in bright sunlight and are more difficult to see compared with monochrome screens, which are unaffected by bright sunlight. To illustrate this point, take a standard laptop outdoors on a bright sunny day and try and use it. An additional drawback of color screens is that they diminish battery life.

- **Are Pocket PC devices more advanced because they have faster processors and more RAM?** These are two features that Pocket PC proponents commonly highlight. However, the actual performance of the device is what needs to be compared, not the nominal processor speed and storage capacity. Similar database applications on Palm devices will execute faster than they will on a Pocket PC device due to decreased overhead in the Palm operating system. Pocket PC devices have more RAM and faster processors because of the enormous overhead required by the Microsoft Pocket PC operating system.



● **Will I have to wait on the device to input data?** During field data collection, rapid navigation between forms is critical. PDA users are mobile and require fast access to input and retrieve data. If a user has to wait on a device to store or retrieve data, then they may not be able to keep up with what needs to be recorded. Database applications written for Pocket PC devices typically run slower than similar applications on Palm devices.

● **Can I backup my data onto a SD/MMC card?** Yes, both Pocket PC and Palm OS based devices have adequate capabilities for backing up critical data. Most devices either are equipped with a flash card or a SD/MMC slot. These slots support both expansion and backup cards, both of which can be used for backing up data.



● **Will the software run on any Palm OS device or any Pocket PC device and what happens if I purchase a new device, will the software operate on it?** In this respect, Palm clearly has an advantage. Both Palm and Microsoft make significant enhancements to the capabilities of their operating system each year. Microsoft changes include Windows CE, Pocket PC 2000, Pocket PC 2002, Pocket PC 2003. If software was designed for Windows CE it is unlikely that it will operate on a device running Pocket PC 2003 or any of the other operating systems. On the other hand, Palm provides backward compatibility such that each time the operating system changes the developers are not required to re-write their existing software. Dataforensics has written applications that will operate devices that run any of the Palm operating systems that Palm have been released since 1999 (OS 3.0, 3.5, 4.0, 4.1, 5.0, 5.1, and 5.2).

● **Are there any software applications that may be required to run the PDA software?** Possibly, if a RAD (rapid application development) tool was used to create the software, you may be required to purchase a "booster" for the device that allows the software to operate. Not all devices have "boosters" available, so the software may not operate on all the devices. PLog does not require such a booster, so it will run on any Palm OS device that runs OS 3, 4 and 5.

Benchmarks

To highlight the some of the statements above, a comparison of the performance of two PDA-based field borehole logging systems is described. The two devices used in the testing are: a Palm M500 device that has a 33MHz Motorola Dragonball processor and 8 MB of RAM; and a Pocket PC based Dell Axim X5 device that has an Intel 300 MHz ARM processor with 32 MB of RAM. The Pocket PC device has a processor that is nearly 10 times faster and has 4 times the amount of RAM compared to the Palm.

Performance Benchmark 1: Compare the time delays associated with first starting the software.

There should be a nominal startup time associated with configuring the software after it is first installed. Each time thereafter, starting the application should be nearly instantaneous.

PLog software and a similar PDA-based field borehole logging system for the Pocket PC are compared first.

- When you first run the PLog software after installing it on the PDA, it takes approximately 4 seconds to load the application. If you exit the application and re-start it, it takes approximately 1 second to re-load each time thereafter.
- When you first run similar PDA software on the Pocket PC device it takes approximately 20 seconds to load the application. If you exit the application and re-start it, it takes 20 seconds to reload the application.



Advantage: PLog.

Performance Benchmark 2

Compare the time delays associated with navigation between forms in the software. PLog and the similar field borehole logging system for the Pocket PC are compared first.

- When navigating among forms in the PLog software, there is no noticeable delay. Navigating from a project to a borehole incurs no noticeable delay.
- When navigating among forms on a Pocket PC device, there is a delay of 3-5 seconds when changing from a project to a borehole, or a borehole to a stratigraphy description. As more records are input the delay becomes longer.

Advantage: PLog

Performance Benchmark 3

Battery life comparison. The comparison is performed using an M500 and a Dell Axim X5 during normal field logging conditions.

- The battery life of a M500 device is approximately 2 weeks using the device 8-10 hours a day during fieldwork.
- The battery life of the Dell Axim X5 is 4-6 hours using the device for similar types of fieldwork.

Other comparisons have been made and the results are similar. Table 1, adapted from Rhodes & McKeehan (2002), highlights the discrepancy in battery life for a variety of devices.

Device Type	Manufacturer's claimed battery life	Battery type	Display Type	Backlit display	Processor Speed
Pocket PC Devices					
Casio Cassiopeia E-125	8 hours	Lithium ion	Color	Yes	150 MHz
Compaq iPAQ H3650	12 hours	Lithium polymer	Color	Yes	206 MHz
Compaq iPAQ H3150	14 hours	Lithium polymer	Grayscale	Yes	206 MHz
HP Jornada 525	8 hours	Lithium ion	Color	Yes	133 MHz
HP Jornada 545	8 hours	Lithium ion	Color	Yes	133 MHz
HP Jornada 548	8 hours	Lithium ion	Color	Yes	133 MHz
Palm OS Devices					
Palm IIIC	14 days	Lithium ion	Color	Yes	20 MHz
Palm m505	21 days	Lithium polymer	Color	No	33 MHz
Palm m500	21 days	Lithium polymer	Grayscale	Yes	33 MHz
Handspring visor Prism	14 days	Lithium ion	Color	Yes	33 MHz
Handspring Visor Edge	28 days	Lithium ion	Grayscale	Yes	33 MHz
Sony Clie PEG-N710C	15 days	Lithium polymer	Color	No	33 MHz
Palm VIIx	2-4 weeks	2 AAA	Grayscale	Yes	20 MHz
Palm m100, m105	4.3 weeks	2 AAA	Grayscale	Yes	16 MHz
Handspring Visor	6-8 weeks	2 AAA	Grayscale	Yes	16 MHz
HandEra 330	4-8 weeks	4 AAA	Grayscale	Yes	33 MHz

Table 1. Summary of Device Types and Battery Life (Rhodes & McKeehan)

The manufacturer's stated battery life for most Pocket PC devices is approximately 8- 12 hours, however it is generally about 50% of the

manufacturer claimed time if using the devices continuously. The battery life for Palm devices is typically 65% of the manufacturer’s stated battery life.

Advantage: Palm

A second round of benchmarks was performed to compare a newer device, the Palm Tungsten E2, which has a color screen, 200 MHz ARM processor and 32 MB of RAM. The results were nearly identical as summarized below:

- When first starting PLog, there was a delay of approximately 2 seconds. Each subsequent restart of the application, there was no noticeable delay.
- When navigating among forms in PLog, there was no noticeable delay
- The battery life of the Tungsten E2 is approximately 12-14 hours as opposed to 2 weeks for the M500.

Software Considerations

How does the system require the user to input data?

Inputting data on a PDA potentially can be cumbersome compared with inputting it on a desktop or laptop computer. Good PDA software design must overcome this by allowing the user to select items from the interface instead of typing or using the handwriting recognition or Graffiti data input.

For field logging software, there are several possible scenarios for inputting descriptions of soil or rock.

- One is to have a list of several hundred possible soil types from which the user can select. This option is cumbersome at best due to the large amount of scrolling necessary to find the specific soil type needed.
- Another option is to allow the user to type in the entire soil description manually and aid the user with an auto-complete mechanism. The auto-complete mechanism recognizes potential alternatives when the user inputs the first several letters of a word. This alternative is marginal at best, because writing or typing long descriptions on a PDA even for the most proficient users can be frustrating.
- The best approach, which requires more sophisticated software but yields a superior final product, is the alternative that allows the user to select description components, such as major constituent, minor constituent, color, moisture, USCS classification, etc. from a series of lists along with a general comments field for attributes that cannot be accounted for in the lists. This allows the user

to generate comprehensive descriptions very rapidly. This also enables the descriptions to be formatted and ordered in the final output however the user desires. PLog was designed with this user-oriented approach.

Advantage: PLog

Does the software enhance the data collection or is it simply a digital version of the paper-based data collection?

Ideally, digital collection systems should enhance the data collection process. Digital data collection systems should provide checks to ensure data is input if it is required; perform routine calculations to eliminate potential human errors; help ensure consistency and completeness of the data. Essentially, the software should act as a “smart form.” No other software on the market can provide the capabilities listed above. The items below detail how PLog is able to enhance data collection.

- **PLog enables you to collect data.** Formatting of data does not occur in PLog because field users should be concerned with obtaining the most accurate data they can record, not how to format it. For example, there is no reason to be concerned about how a specific client wants to visualize SPT blow counts, N values, soil and rock descriptions, water levels, etc. All formatting occurs during the report generation, or data transfer to a report generation program. As an example, in PLog, the user records just the blow counts. PLog calculates the N-value for the user. Additionally, all formatting for reporting the blow counts occurs in the office. All other field data collection software requires you to record formatted data, which makes data input in the field more difficult and cumbersome.
- **PLog guides the user through the data collection process.** PLog ensures consistency and completeness by guiding the user through the data collection process and allowing the user to select attributes that are recorded in the field from various user interface elements, such as lists, checkboxes and buttons. Other software applications make the user type or write nearly everything.
- **PLog validates your data.** PLog performs calculations automatically for blow counts, percent recovery, RQD, RMR and various other common calculations. PLog further eliminates the potential for human errors by determining the consistency or relative density based on blow counts from SPTs.
- **PLog enforces consistency within an organization.**
 - Users customize the values in the drop down lists to an organization’s standards. All PLog users must select values from these lists.

- Users enter description data in components. This enables nearly any description format to be developed after the data is input. Ordering and formatting of soil and rock descriptions is automated and performed per an organization’s standard. This eliminates human error associated with ordering, formatting and typographical mistakes during the description development process.
- **PLog’s predictive text library is an asset, not an annoyance.** PLog’s predictive text library is a geotechnical and geoenvironmental based library. When the user needs to write, PLog uses predictive text to minimize the writing the user must perform. This means when a user writes “sa”, “sand” appears instead of “San Diego”.
- **Data on PLog is easily reviewable.** Reviewing a complete boring log on a PDA is impractical. A user would not be able to read it. However, for each data type in PLog (sample, layer, groundwater measurement, well installation, etc), there is a summary screen where the user can review the depth for each item and what is recorded at that depth. A user can quickly recall the depth they are at for a specific borehole simply by returning to the review screen. No scrolling through individual samples or layers is necessary.
- **PLog allows data to be copied between boreholes.** Copying data increases consistency of data. PLog allows users to copy entire boreholes or individual lithology and sample descriptions between boreholes. Once copied, depths and descriptions are easily edited by selecting items on a summary screen.
- **PLog automatically fills in data within a borehole where applicable.** PLog automatically fills in borehole information such as driller, drilling company, drill rig, logger, drilling method, and backfill method after the data has been entered for first borehole. If borehole information does change, the user simply has to select another value for the field to update it.
- **PLog integrates with other digital devices.** PLog integrates with NMEA compliant GPS units via Bluetooth or wired connection. This feature allows a high level of accuracy without human error resulting from transcription errors of location data.

PLog enhances the user’s experience by collecting field data and organizing it so the user can access it easily on the PDA and reuse it as necessary.