

## Using Handheld Pen-Based Computers for Maintenance

Written by Richard S. Rothschild  
Sunday, 01 November 1998 12:14

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**Although no single portable computer is best for every application, chances are there is or soon will be a lightweight handheld unit that can fully serve any set of maintenance needs better, faster, and at less cost.**



Pen tablet computers allow the technician to collect vibration data and perform trend analysis based on FFTs to find impending problems, evaluate their urgency, uncover root causes, and perform balancing. Photograph courtesy Vibration Specialty Corp., Philadelphia, PA. Powerful handheld pen-based computers that have appeared in the past few years can provide a field technician performing on-site inspection and maintenance with all the computer power he needs to do his job swiftly and efficiently, whether it is integrating his operations with the computerized maintenance management system or testing, diagnosing, and repairing equipment on the spot. One powerful handheld digital device can be programmed to satisfy a wide variety of data collection and service needs. For the real-time management of maintenance operations, a handheld with modem or wireless can serve as a smart two-way home-base communicator.

In the past, data collectors and service instruments had to be designed for a specific task in order to achieve small size and high performance at a reasonable price. With a low cost but powerful personal computer (PC), a variety of tests could be performed as well or better, with the computer's function easily altered through software. One PC could replace an entire laboratory of equipment. However, because PCs were heavy and fragile, special portable devices were still needed in the field to make tests or collect data.

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Although comparatively light weight, the laptop computer with its mouse, keyboard, and flip-up screen was not ideal for operation by plant personnel. It often quit in harsh environments—it was never intended to operate in a refinery in Texas under the summer sun, at an Arctic pipeline in the winter, in a paper mill's humidity, in a rolling mill's dirt and dust, or to survive an accidental drop on a concrete floor.

### Handheld pen computers

For industry and the military, the problems with using laptops in the plant or the field are being solved by handheld pen-based computers—a pen tablet or a personal digital assistant (PDA). To date, the pen tablet—almost as powerful as a laptop but smaller and lighter—has been widely deployed with a barcode reader to check inventories, confirm truck deliveries, track rental car returns, or link with utility field-service teams.

While the pen tablet is a full Windows 95-based computer, the PDA runs on the simpler Windows CE or a proprietary operating system, providing limited power. Both are designed for field use, but only pen tablets are available in industrial-strength ruggedized versions. Although widely different in display, storage, and computing power, both use point-and-click “pens” to select menu items for easy operation. Some also include handwriting recognition software although with limited success. For a more detailed comparison of laptops, pen tablets, and PDAs, see the accompanying section “Alternatives to Pen Tablets.”

Two versions of the pen tablet are available—one intended for standalone operation, the other as a remote client for a home-based server. The standalone is a full computer incorporating hard disk storage and fast Pentium processing. The remote client type depends on a remote host server, continuously linked by wireless technology or modem, to provide all storage and processing power. In effect, the client is a stripped-down pen tablet, acting as a remote terminal for display and data entry only. PDAs fitted with wireless communications also can serve as remote clients, although their cramped displays are less than ideal.

### In the field

There are three areas of application for portable computers in industrial maintenance:

- As a data collector and/or analyzer for on-site maintenance decisions
- As a field service tool to aid in performing maintenance
- As a management tool for control of maintenance operations

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Although the use and type of computer differs for each application, there are a number of advantages for computer-based maintenance.

**More reliable data is obtained.** Error-prone, hand-written records are replaced by reliable data, automatically gathered, stored, and consistently available throughout the enterprise. Bar codes identify inspection locations reliably, ensuring verifiable route compliance that satisfies even regulatory agencies.

Record keeping costs are reduced. Less paperwork lowers administrative overhead because data is processed more efficiently and disseminated widely without producing redundant copies—or even any printed record at all.

**Use of resources is more efficient.** One simple device can be programmed to serve multiple purposes. Mobile workers perform better and faster without having to learn multiple devices. Material and equipment can be allocated more effectively. With all necessary information—schematics, design and safety specifications, installation drawings, operating parameters, replacement parts lists, etc.—available on demand on site, downtime is reduced and less time is wasted on repeat visits by the technician.

**Decision making is faster and more cost-effective.** By integrating real-time field reports with the computerized maintenance management system (CMMS), managers at all levels share complete, up-to-the-minute information, and can react quickly to changing field conditions or emergencies. Condition monitoring tests involving a number of parameters—vibration, heat, oil quality, pressure—can be compared quickly to confirm impending problems before they become catastrophic.

### Data collection

Maintenance starts with knowing what is going on—how equipment is operating, what increased stresses are being applied, how conditions have changed. Data must be collected, either by a remote monitoring system or by workers on-site. In the latter case, the handheld computer makes data collection faster, more accurate, and more flexible.

In its simplest mode, local instrument readings are entered manually in a pen tablet or PDA then downloaded to a central server. Downloading usually occurs at the end of the day either directly via hardwire or infrared interface, or remotely via modem or wireless link.

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Point-of-access data recording has the advantage of allowing the field technician to append pertinent information.

Most pen tablets and some PDAs allow the addition of bar code readers through their serial ports. Bar codes, commonly used to identify parts in inventory, also provide identification of inspection sites where readings are taken. Appended to the actual data, bar codes can be used to verify inspection route compliance in critical facilities such as nuclear power plants.

The U.S. Navy plans to expand the use of their pen tablets, currently under trial for collecting machine vibration data for predictive maintenance, by adding manually entered dial readings of temperature, pressure, etc. Eventually they plan to use the pen tablet for acoustic analysis and to access networks and generate repair orders, increasing technician efficiency and reducing the number of instruments with which he must be supplied.

A commercial system is currently available that uses the power and flexibility of the pen tablet for multi-channel vibration data collection and Fast Fourier Transform (FFT) analysis. Because of the pen tablet's mass storage, a complete archive of previous data and sophisticated programs is available on-site for trend analysis, alarm, and failure diagnostics.

Pen Tablet Manufacturers Offering DOS or Windows Operating Systems      [AMCI](#) [www.novia.net/](http://www.novia.net/)

- [CimWorks](#) [www.CimWorks.com](http://www.CimWorks.com)
- [Cruise Technologies](#) [www.cruisetech.com](http://www.cruisetech.com)
- [Dauphin](#) [www.dauphintech.com](http://www.dauphintech.com)
- [Data Entry Systems](#) [www.data-entry-systems.com](http://www.data-entry-systems.com)
- [Epson](#) [pos.epson.com/handheld](http://pos.epson.com/handheld)
- [Fujitsu-ICL](#) [www.fjicl.com](http://www.fjicl.com)
- [IBM](#) [www.networking.ibm.com/wireless](http://www.networking.ibm.com/wireless)
- [Intermec](#) [www.intermec.com](http://www.intermec.com)
- [Itronix](#) [www.itronix.com](http://www.itronix.com)
- [Melard](#) [www.melard.com](http://www.melard.com)
- [Microslate](#) [www.microslate.com](http://www.microslate.com)
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- [Motorola](#) [www.mot.com/LMPS/RNSG/portables](http://www.mot.com/LMPS/RNSG/portables)
- [Norand](#) [www.intermec.com/products](http://www.intermec.com/products)
- [Panasonic](#) [www.panasonic.com](http://www.panasonic.com)
- [PGI Data](#) [www.ivpgi.com](http://www.ivpgi.com)
- [Ramline](#) [www.ramlinemobile.com](http://www.ramlinemobile.com)
- [Symbol \(pen clients\)](#) [www.symbol.com](http://www.symbol.com)
- [Teklogix](#) [www.teklogix.com](http://www.teklogix.com)
- [TelePad](#) [www.telepad.com](http://www.telepad.com)

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[Telxon](http://www.telxon.com) www.telxon.com  
[Texas Micro](http://www.texasmicro.com) www.texasmicro.com  
[Walkabout](http://www.walkaboutcomp.com) www.walkaboutcomp.com  
[XL Computing](http://www.xlcomputing.com) www.xlcomputing.com  
[Xplore](http://www.xplorettech.com) www.xplorettech.com

### Handhelds as a service tool

A portable computer also can aid in actual servicing. Its internal storage can provide information on design and operation of the device being worked on, as well as safety codes, standards, installation drawings, and equivalent replacement parts. The small screen and memory of a PDA limits the information that can be displayed. A pen tablet, on the other hand, is ideally suited to store and display complex graphics. Where a machine's operating or maintenance history is pertinent, it may be downloaded to the pen tablet's hard drive or solid-state drive either directly from the server before going on location or later on-site via a communications link.

Typical of operations requiring rapid-response maintenance at remote locations are refineries, pipelines, power generating stations, rolling mills, paper plants, auto assembly plants, large machine shops, and utilities. For example, field technicians at Nynex use a pen tablet during servicing for remote control of loop assignment switching as well as to collect and view line data.

Operations which require computer control and read out, such as balancing or alignment, can be programmed into a handheld computer, although they usually require the advanced processing and graphic capabilities found only in a pen tablet.

A pen tablet also can be expanded for use as a number of different test instruments. With the addition of input analog-to-digital conversion, a pen tablet-based system can be programmed to serve not only for balancing and alignment, but also as a digital chart recorder, digital oscilloscope, digital voltmeter, or dual-channel FFT structural analyzer.

Recognizing this potential, the U.S. Navy is developing a multi-channel analog-to-digital (A/D) and signal conditioning card, specifically designed for the pickup of vibration or other dynamic signals, and packaged to plug directly into the PCMCIA card slots available in pen tablet computer. Various PCMCIA A/D cards are also available commercially from a number of manufacturers specializing in plug-in cards.

### The computer as a management tool

A pen tablet or PDA with communications capabilities can serve as a link between a CMMS and the field. Timely information from the repair site is available to managers for rapid decision-making to optimize plant utilization. Field personnel are quickly redirected to where they are most needed, while providing all the information they require to maximize their effectiveness such as work orders, availability of resources, spares inventory, and safety standards. A number of CMMS suppliers favor a PDA because of its small size and because its reasonable cost can make it practical in some cases to discard a damaged PDA and replace it with a new one.

Personal Digital Assistant (PDA) Manufacturers Offering Windows-CE or Proprietary Operating Systems [3Com](#) [www.palmpilot.3com.com](http://www.palmpilot.3com.com)

[Casio](#) [www.casiohpc.com](http://www.casiohpc.com)

[Compaq](#) [www.compaq.com/products/handhelds](http://www.compaq.com/products/handhelds)  
E.Com (NA)

[Everex](#) [www.everex.com](http://www.everex.com)

[General Magic](#) [www.genmagic.com](http://www.genmagic.com)

[Granite](#) [www.gcicom.com](http://www.gcicom.com)

[Hewlett Packard](#) [www.hp.com/handheld](http://www.hp.com/handheld)

[Hitachi](#) [www.hitachi-ce.com/HPCIBM.htm](http://www.hitachi-ce.com/HPCIBM.htm)

[IBM](#) [www.pc.ibm.com/us/workpad](http://www.pc.ibm.com/us/workpad)

[LG Electronics](#) [www.lgphenom.com](http://www.lgphenom.com)

[NEC](#) [www.nec-computers.com/products/mobilepro](http://www.nec-computers.com/products/mobilepro)

[Panasonic](#) [www.panasonic.com](http://www.panasonic.com)

[Phillips](#) [www.velo1.com;www.nino.philips.com](http://www.velo1.com;www.nino.philips.com)

[Novatel Wireless](#) [www.novatelwireless.com](http://www.novatelwireless.com)

[Psion](#) [www.pSION.com](http://www.pSION.com)

[Sharp](#) [www.sharp-usa.com](http://www.sharp-usa.com)

[Symbol](#) [www.symbol.com](http://www.symbol.com)

[TI](#) [www.ti.com/organizers/avigo](http://www.ti.com/organizers/avigo)

[WPI Husky](#) [www.wpihusky.com](http://www.wpihusky.com)

### Communicating to and from the field

Where sufficient data and programs can be retained at any one time in the PDA, intermittent communication (at the start or end of the work day) via wire modem or local connection to the server is practical. In many cases, however, the PDA does not provide enough storage or processing power. Either a more powerful handheld computer such as a pen tablet must be used, or the PDA must be employed solely as a remote terminal or client in communication with a more powerful server.

Putting all computer power in the server allows the client to be lighter, less expensive and,

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without the need for a hard disk, more reliable. Only the server needs to be provided with state-of-the-art processing, making periodic upgrades easier. Because data resides on the server, there is less chance of losing data if a client fails in the field. A multi-unit system is more economical with many lower-cost clients and only one expensive server. Disadvantages include limitations in current modem and wireless data transfer rates and, most important, the need to maintain continuous clean links in remote locations where wireless communication is problematical.

Some units can send information back to the server using Cellular Digital Packet Data (CDPD). CDPD transmits digital packets within the unused bandwidth of analog cellular telephone, but works only where a special CDPD network is locally available (at a monthly access charge). Its speed of 19.2 K-bps is sufficient for text, but downloading any but the simplest graphics is prohibitively slow. Also, the addition of CDPD and its dedicated modem seriously tax a PDA's battery.

In many applications, a PDA is not powerful enough to serve even as a client. Its processing capabilities, screen, and battery are all too weak. Wherever photographs, detailed schematics, layout diagrams, or other graphic-intensive information is needed in the field, a more robust computer is called for. Some manufacturers build their clients around pen tablet-type handhelds with a Windows 95 operating system and a large screen.

Handheld pen-based pen tablets are sufficiently powerful and rugged to perform virtually any computer-based industrial maintenance function in the harshest of environments. Many of these units, complete with typically delicate hard drives, are designed to withstand the shock of dropping 3 feet onto a concrete floor. They also operate at the temperature extremes where humans have difficulty working—from below zero to more than 120 F—and withstand almost 100 percent humidity or driving rain.

As batteries improve and circuitry becomes smaller and less power hungry, the future may see the introduction of such powerful maintenance tools as a high-speed, digital cellular modem (with universal coverage) integrated into a large screen pen tablet, putting the field technician in real-time contact worldwide with his home base and all its data. **MT**

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*Richard S. Rothschild has 18 years experience with a major manufacturer of real-time FFT*

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