



**Using Handheld Devices
to Gather and Manage
Electronic EH&S Information on Campus**

October 1, 2004



White Paper

The Campus Consortium for Environmental Excellence

The Campus Consortium for Environmental Excellence (C2E2) is a national, nonprofit, organization comprised of colleges and universities dedicated to improving their environmental performance on campus. The C2E2 was founded in 1997 to represent certain colleges and universities in successfully negotiating a pilot project with the U.S. Environmental Protection Agency to spur regulatory activity on an alternative regulatory model for managing hazardous wastes in academic laboratories. Since the time of this pilot project, the focus of the organization has broadened from laboratory issues to environmental topics that affect the larger campus, and membership in the C2E2 has expanded.

The mission of the C2E2 is to support the continued improvement of environmental performance in higher education through environmental professional networking, information exchange, the development of resources and tools, and the advancement of innovative regulatory models. Environmental performance is defined to include campus regulatory compliance, environmental management and sustainability initiatives.

C2E2's mission is carried out through bi-monthly meetings, active workgroups and projects identified by the Consortium's membership. More information on the organization, its activities and members can be found at www.c2e2.org or by contacting either Tom Balf at tbalf@c2e2.org or Peter Schneider at schneider@bu.edu.

This document has been produced by C2E2, under the direction of its members, for the benefit of all colleges and universities. Our current membership is listed below.

C2E2 Member Institutions

Boston College	Boston University
Brown University	Cornell University
Georgetown University	Harvard University
Massachusetts Institute of Technology	Northeastern University
Princeton University	Rhode Island School of Design
Trinity College	Tufts University
University of Alaska	Univ. of Massachusetts – Boston
Univ. of Massachusetts - Dartmouth	University of Rochester
University of Vermont	Wellesley College
Williams College	Worcester Polytechnic Institute
Yale University	

Introduction and Acknowledgments

Preface:

The Campus Consortium for Environmental Excellence (C2E2) is proud to introduce this White Paper “Using Hand-Held Devices to Gather and Manage Electronic EH&S Information on Campus.” It is our first White Paper or Report, but the latest in a series of C2E2 tools designed to assist colleges and universities improve their environmental performance.

The purpose of the Paper – and the workshop that we held prior to the development of the paper -- is to assist College/University Environmental, Health and Safety Departments in exploring the use of handheld devices. According to our research, experiences at colleges and universities across the country indicate that handheld technology is becoming an important tool for many EH&S departments in information collection, management and dissemination. It has been less successful at other campuses. The key to success is identifying goals at the appropriate level of technological sophistication based on a college or university’s specific business process, staff, financial and IT resources. Benefits from the use of handhelds can be gained even with small steps. By continuously considering how technology can support EH&S operations, small initiatives can grow appropriately to meet broader institutional needs. We believe that this White Paper will support those steps at colleges and universities of all sizes and at varying stages of technology deployment.

We encourage the distribution and use of this White Paper. The document is available on our website for downloading and printing at www.c2e2.org/handhelds, and many of the Figures and Tables will be available as distinct files on our website for use by institutions in in-house presentations. We ask only that attribution be given to the C2E2.

Acknowledgements:

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We especially thank Pfizer, Inc., a founding sponsor of the C2E2, whose generous contribution enabled the C2E2 to fund this project.

Contents

The Campus Consortium for Environmental Excellence

Introduction and Acknowledgments

Implementing Handheld Devices on Campus

What is this paper about? 1

How to use this paper? 1

Why use handheld technology? 2

What is involved in implementing handheld technology? 2

 Planning Stage 4

 Design Stage 7

 Build Stage 8

 Hardware 8

 Software 12

 What about training? 12

 Check and Act Stage 13

Conclusions 13

Scenarios and Case Studies

Get Started Scenarios 14

Case Studies 15

 Rhode Island School of Design 15

 Northern Illinois University 15

 New Mexico State University 16

 Boston University 16

 Cornell University 17

 University of Utah 17

 University of Kansas 18

 University of North Carolina 18

 Harvard University 19

Glossary 21

References 20

Online Resources 21

List of Figures

Figure 1. Project Elements 3

Figure 2. Common EH&S Processes 4

Figure 3. Example Inspection Workflow 4

Figure 4. Resources and Goals 5

Figure 5. Range of Sophistication 6

List of Tables

Table 1. Benefits of Handhelds 2

Table 2. Stakeholder Roles 6

Table 3. Prioritized Considerations 7

Table 4. Hardware Evaluation 10

Table 5. PDA Comparisons 11

Table 6. Software 12

What is this paper about?

Expanding the use of technology to support data management efforts is a growing area of interest for College and University Environmental Health and Safety (EH&S) Departments. Recognizing this, the Campus Consortium for Environmental Excellence (C2E2) began an initiative aimed at assisting College and University EH&S staff in adopting and implementing the use of handheld technology to support ongoing operations.

In May of 2004, C2E2 sponsored a workshop "Using Handheld Devices to Gather and Manage Electronic EH&S Information on Campus" at the University of Massachusetts's Boston campus. At this event, case studies were presented and information was shared about hardware, software and experiences. Details and presentation materials are available at: http://www.c2e2.org/pda_workshop/index.htm.

Building on this workshop, C2E2 engaged CDM to develop this White Paper to assist College/University EH&S Departments in pursuing the use of handheld devices. For the purposes of this research, "Handhelds" refer to any portable technology device used to collect EH&S data in the field. This includes Palm Pilots, PocketPCs, laptops and tablet PCs.

Research for the paper began with a web-survey of College/University EH&S staff about interests in, and experiences with, handheld technology. At the time the paper was written, there were 70 respondents to the survey, both named and anonymous. The experiences from the survey are presented throughout this paper. Research for this paper also included a literature review and input from information management and EH&S professionals. A review of EH&S software tools for use on handheld devices was beyond the scope of this paper. However, information collected in the survey on the use of software by peer organizations is presented.

How to use this paper?

The goal of the paper is to provide a general framework for assessing departmental operations and evaluating handheld technology to support these operations. There are a number of questions that must be addressed when considering embarking on a handheld project. These questions are presented and addressed in this paper.

Information collected as part of the web-survey, and follow-up communications with survey respondents has been compiled and is presented in the Scenarios and Case Studies Section, as well as in the section on software. Two "quick-start" scenarios are presented, as well as summary information about handheld projects at peer institutions. For guidance on terminology, a Glossary of Terms has been included at the end of the document.

This paper has been designed to provide guidance to small departments with little or no formal information management support as well as for larger departments with dedicated staff. The message from the survey was clear -- handheld technology has a role in enhancing EH&S data management, regardless of resources. We hope this paper provides the information necessary to take the first step on the road to handheld technology as well as serving as a resource for the growth of existing projects.

Why use handheld technology?

There are a number of strong reasons to consider using handheld technology to collect data in the field. These include:

Table 1: Benefits of Handhelds

Reduced time to complete tasks	Eliminate review of paper, data entry
Improved data quality and consistency	Build data checks into application, eliminate data entry errors
Improved access to data and communication	Databases for data analysis and reporting
Improved compliance	Able to visit more locations, better ability to review past history

In considering whether to pursue using handheld technology at all, it is a good idea to follow experience-based instincts. Processes that involve referencing information or collecting data while in the field are good candidates, as are those involving data collection in the field.

What is involved in implementing handheld technology?

Embarking on a handheld project may seem daunting and resource intensive, but it is possible to implement handheld technology that provides tangible benefits with limited budget and resources. The key to a successful project is upfront planning and focus on the process requirements. The technology should not be the driving factor. Process improvements can be made using simple technological tools.



There are four general stages to a technology project:

- Plan – upfront assessment of process requirements.
- Do – design and build system.
- Check – test implementation of system and evaluate.
- Act – complete implementation and continue to evaluate.

This is not a linear set of actions, but rather a process of continuous evaluation and assessment. Throughout all stages, attention must be paid not only to technology (hardware and software) but also to the EH&S business processes being considered and the people involved. This relationship is depicted in Figure 1.

Business process refers to the basic flow of tasks associated with specific EH&S responsibilities, such as those activities necessary to complete an inspection or measure hazardous waste disposal. Some processes are better suited to handheld tools than others. Processes that involve data collection out of the office where the data is numeric or has a discrete set of values are well suited to the application of handheld technology, as are those that can benefit from references to large volumes of information that can be condensed electronically. Selection of the appropriate business process is a key factor in the success of a handheld project.

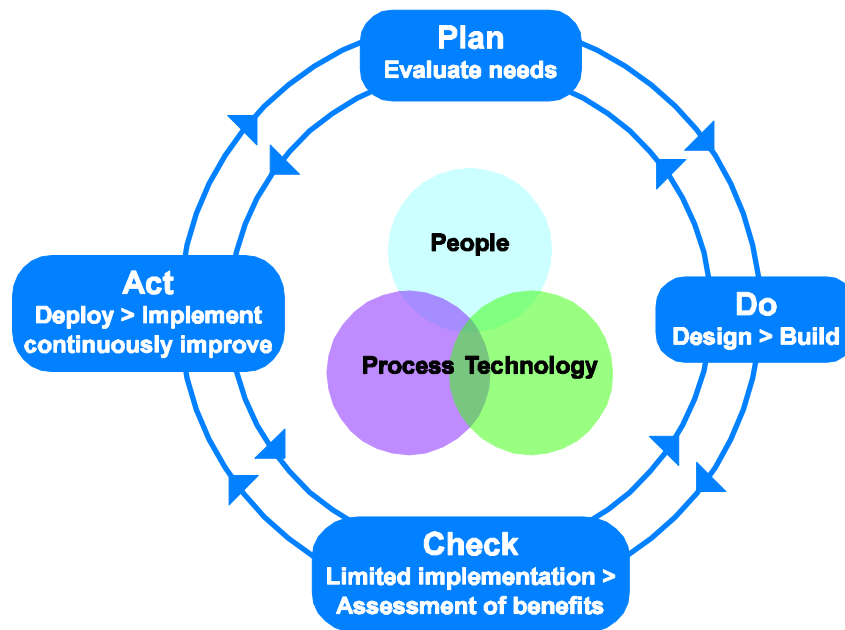
A project's success is also closely tied to the staff and other stakeholders affected by the change in processes due to the introduction of handheld technology. Staff ownership of the new tools and processes is vital to the success of the program.

The final element of project success is the selection and development of the hardware and software technology itself. Hardware includes items such as handheld devices, bar-code readers, and digital photo attachments, as well as the supporting desktop hardware to support a central database. Software may be

specific commercial products that support EH&S functions out of the box or software that requires some level of development to meet defined EH&S needs.

EH&S professionals should focus on the process and stakeholder issues. This includes determining what the processes should be and how to apply the handheld hardware. It is then advisable to utilize qualified information technology (IT) resources for the build and implement tasks, either in-house or through vendors or consultants, when necessary.

Figure 1: Project Elements



The following text focuses on the issues that need to be considered in planning, designing and building new EH&S processes using handheld technology.

Planning Stage



Planning begins with reviewing current conditions and defining goals. These are two of the most critical steps when embarking on a handheld project.

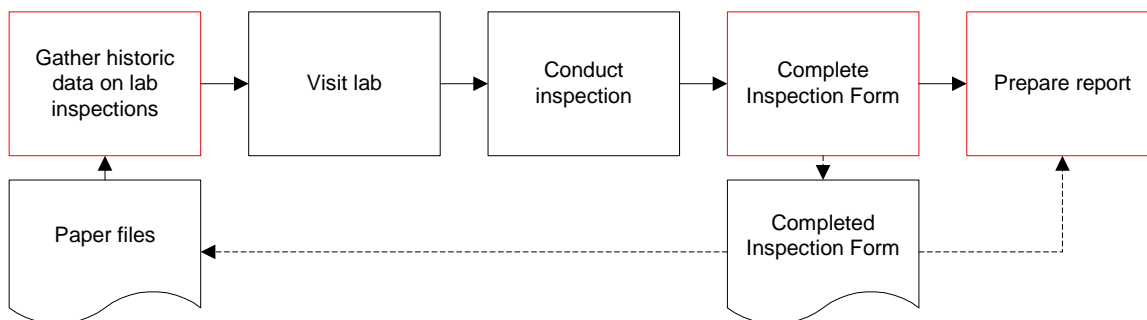
Begin by identifying the business processes that will be addressed with handheld technology. Common EH&S processes that are well suited to handheld data collection include:

Figure 2: Common EH&S Processes



Experience should be the guide in selecting processes for which handheld technology is appropriate. For a specific process under consideration, it is helpful to sketch a simple workflow diagram. This will identify areas in the processes that can be enhanced with the use of handheld tools. An example is shown in Figure 3.

Figure 3: Example Inspection Workflow



To assess current conditions, consider the following questions:

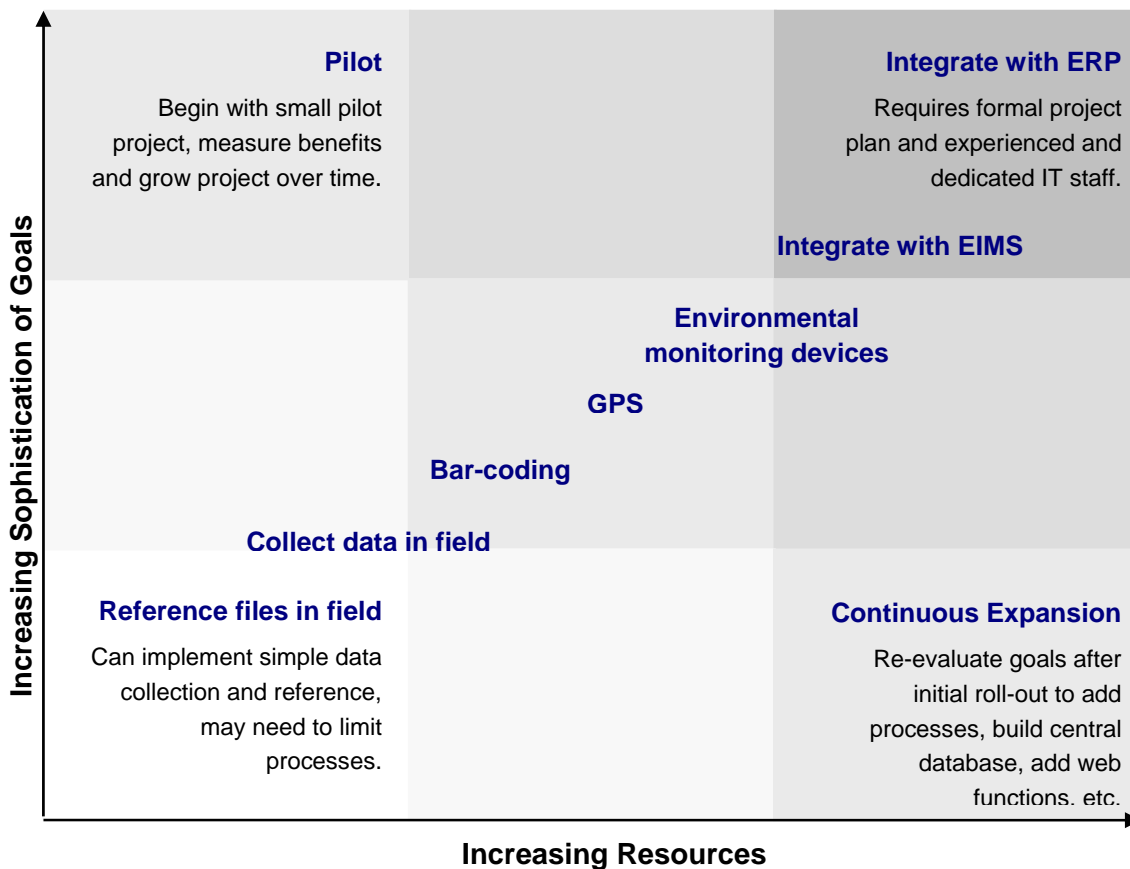
- What are your current processes like? Are they paper based, is there any electronic storage of data? Is paper storage required? Are there regulatory drivers related to data format and transmittal?
- What are your IT resources? Do you have programmers or dedicated IT staff within EH&S? What is your relationship with the IT department? Are student resources available?
- What is your budget? Will budget conditions change/improve?

The next step is to establish your goals regarding information collection and management within EH&S:

- Basic data entry to reduce use of paper and make data more accessible.
- Improve data quality and consistency by minimizing erroneous data.
- Collect additional data such as photographs, sketches, bar-coding or GPS.
- Develop comprehensive environmental data management system.
- Integrate with Institution’s system.

The specific actions to take depend on the Department’s current conditions and sophistication of goals, as illustrated in Figure 4.

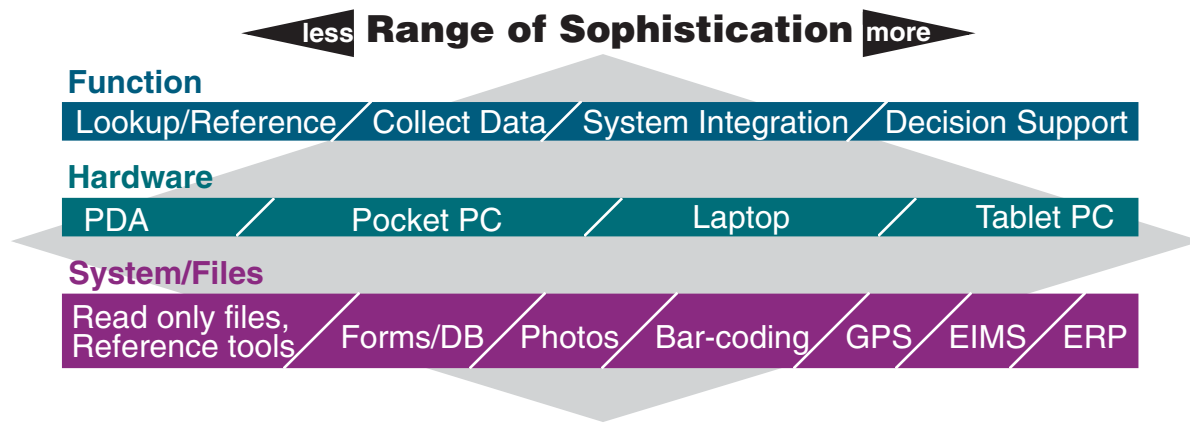
Figure 4: Resources and Goals



GPS = Global Positioning System
 ERP = Enterprise Resource Planning System such as Peoplesoft, Oracle, SAP
 EIMS = Environmental Information Management System, comprehensive environmental database

As depicted in Figure 4, basic goals can be addressed with limited resources, while greater resources are needed to achieve more sophisticated goals. The range of sophistication for functional and system goals and hardware is depicted in Figure 5.

Figure 5: Range of Sophistication



In establishing goals and assessing current conditions it is important to identify and reach out to stakeholders. This is the most effective way to increase the resources at your disposal and to gain support for project goals. Common stakeholders and their roles include:

Table 2: Stakeholder Roles

Stakeholder	Input
Senior Administration	Institutional support Resources
IT Department	Provide Standards May have competitive purchasing power Design support Programming support Implementation support
Facilities Department	Support and input on process changes May have software or hardware that can be leveraged by EH&S
Faculty/Students	Design support Programming and testing support
Vendors	May have free software that can be used Experience
EH&S Staff (end-users)	Input on design Users of system Knowledge of process

Design Stage



Once you have assessed your current conditions and goals, and identified the processes to consider, the next step is to prioritize the business processes to be addressed with handheld technology. Whether you plan on starting with a small set of processes or embarking on a large-scale EIMS projects, a prioritization of processes is useful in managing the project. Recognize that process requirements should drive the development of tools. Some factors to consider in setting priorities include:

Table 3: Prioritization Considerations

Factor	Maximize Value Added
Support from key staff involved in process	Staff that are most comfortable with technology and open to change.
Need for data accessibility	Processes whose data is most valuable in electronic form (numeric data, pick lists, checklists)
Data quality concerns	Processes that can be designed to improve data quality at capture.
Existence and quality of electronic information (i.e. does a database or spreadsheet already exist)	Quick start if electronic data already defined.

Once processes have been selected, the requirements to support those processes must be defined. It is helpful to sketch out the workflow associated with the process, and the tasks that involve data collection, analysis or outputs.

IT staff that will be supporting this project should be brought in during the Design Stage, if they have not been involved prior. If in-house IT staff are unavailable, a consultant can be brought in, or, if budgets are limited, it may be worthwhile to explore the use of student to assist in the project, especially for application development and hardware configuration.

The next question to address is whether commercial EH&S software tools should be acquired or if an application is going to be built in house. For basic data collection requirements, application development can often be easily handled in house. More sophisticated requirements warrant research of the commercial software market.

If the application is going to be developed in house, end-users will work with IT staff to identify the format of specific data elements, the layout of the user interface, and business rules for functionality such as calculations, queries and reports.

During the design stage it may be helpful to receive demonstrations of commercial software. The purpose of the demonstrations should be to develop an understanding of the types of functions that can be purchased. This will help you understand whether or not custom software development will be required during your build stage. If most or all of your needs can be met through the purchase of a commercial product, you may not require any software development resources during the build stage.

There are advantages and disadvantages to using commercial software, often referred to as COTS (Commercial off-the-shelf). The principal advantages may include: (1) the low cost paid compared to the functions available; (2) the availability of a peer group of experienced users who offer assistance and experience in the form of “lessons learned”; and (3) the availability of upgrades that enable you to do more or work more efficiently as time goes on.

The principal disadvantages to the use of COTS products may include: (1) the availability of “too much” functionality that can confuse or frustrate users; (2) incompatibility between how you are used to working and how the software requires you to work; (3) lack of flexibility to make changes in your application; and (4) the need to have a budget item to purchase COTS as opposed to using existing staff to build a system.

Whether COTS products are used or not, most COTS vendors welcome the opportunity to demonstrate their products, and it is well worth the effort at the design stage to become educated about COTS offerings.

Build Stage



In this stage specific decisions are made about software and hardware. It is important to note that the stages presented here outline a logical project progression. However, it is often the case that elements of the planning, design and build stages are not implemented in a linear manner. For example, a software package may be identified by a waste management contractor or by another department, and this may drive the project. Or, specific hardware may be acquired by a staff member or provided by the IT department. In situations such as this there may be fewer decisions to make, but consideration of the project elements here can help organize and focus the effort.

This section addresses some of common questions one must answer with a handheld project.

What Hardware should we buy?

There are numerous options to consider for hand-held hardware. This paper addresses Palm and Pocket PC PDAs, Laptops and Tablet PCs. Most of the respondents of the C2E2 survey were using PDA hardware, with 9% using Tablet PCs and 6% using Laptops. Of those that used PDA's there was an even split between Palm and Pocket PC operating systems, with some institutions using both. (70 institutions responded to the survey: of those, 33 indicated the type of hardware used. The percentages provided represent the % of the 33 that provided hardware information.)

The best hardware for a College or University EHS Department to use depends on a number of factors including budget, intended use, experience of users, institutional standards and IT resources. So, to navigate the seemingly endless set of hardware options, you need to answer a few questions.

1. *What are you going to do with the hardware?*

- a. If you are going to run desktop software applications or want the hardware to serve as someone's personal computer, you should consider a Tablet PC or Laptop. Tablets are better for field data collection because they are designed to support mobile data entry and data entry can be done with a pen device, but they are more expensive than laptops.
- b. If your main goal is to lookup reference information such as the NIOSH pocket guide, any PDA will work. A Tablet or Laptop may be too bulky for this simple purpose, but will work if that is the hardware you have.
- c. If the functional needs include collecting data and synchronizing with another database, a PDA is sufficient, but a Laptop or Tablet may be appropriate if a larger screen size is needed.
- d. PDAs were designed for emailing, scheduling, and maintaining contacts. Make sure the PDA has the software necessary to synchronize with your institution's email system.

- e. If the conditions under which the hardware will be operated provide the possibility of harming the device, then it is appropriate to consider equipment that can safely handle the environment. Increasing levels of protection (ruggedization) for a given device can increase the cost of the device. However, the increase in cost for ruggedization can be applied to the extended useful life of the equipment and may result in a lower overall cost with respect to downtime and replacement of parts or the entire device.

2. *What are your institution's standards?*

It is important to contact your institution's IT Department before making a choice. There may be standards or preferences for you to consider if you want IT support. In addition, there may be purchasing agreements with hardware vendors that enable you to get a better price, or that provide some additional features like software.

The types of standards to consider include type or brand of hardware, operating system software (Palm vs. Windows), database software standards, software requirements such as virus software, browsers, etc. Since many EH&S Departments do not have support from their institution's IT Department some may wonder whether it is worthwhile to approach them on the issues of standards. While this is an institution specific issue, it can be advantageous to make at least an informal inquiry to IT to better understand where your institution is heading with handheld and wireless technology, and to identify if there are others on campus that may have experiences to share.

3. *What other system components must be considered?*

- a. Data collection on a handheld device requires at least one desktop personal computer or server to house a central database. This database is where the data will be reviewed for quality control, and where reporting will be done.
- b. A mechanism must be in place for data to be backed-up regularly, even daily, to ensure that important records are not lost. Backup can be done with a CD or DVD burner if the data is not too voluminous, or with a tape backup for a larger system. It is also important that backups are stored in a different, climate controlled location to ensure their protection.
- c. Virus protection software must be installed on the computers to protect the integrity of the system.
- d. Any computer housing the central database should have an Uninterrupted Power Supply (UPS) device to protect against power failures and surges.

4. *What other requirements are there? Consider these issues when selecting a specific device.*

- a. If your institution supports wireless networks, you should consider buying a device with wireless capabilities. This eliminates the need to synchronize with a central database back in the office.
- b. How mobile do you need to be, and how much data is going to be collected? The screen size of a PDA may be limiting.
- c. How will data be entered? Is a keyboard needed or is a stylus sufficient?
- d. How much wear and tear will the device need to endure? A ruggedized device may be advisable if it will be subject to vibrations, temperature swings, moisture, dust, etc.
- e. Will the end-user be using multiple applications at the same time? If so, this is better supported by Pocket PCs, Laptops and Tablets.
- f. Will the device be used in direct sunlight or at night? Vendors should let you test out the device under various working conditions to make sure it meets your needs.
- g. How long of a battery life is needed? Is it possible to get extra batteries or a car charger?
- h. What type of external connectivity will the device need for cameras, bar-code readers, monitoring equipment etc.?

5. *Have you selected specific software?*

If specific commercial software is going to be used, ask the vendor for recommendations on the type of handheld hardware and operating environment (Palm or Windows). There is also free software available from regulators, vendors such as insurance companies (Marsh) and contractors (waste management companies) that may be designed for a particular type of hardware.

6. *Will you be developing software?*

If software is going to be developed, identify developers and select the environment that fits their skills/experience. If the developers are new to both environments, many feel that Palm is a good choice because there is a greater amount of freeware available, while others like the power of the Microsoft environment. It comes down to a matter of personal preference and institutional standards.

Once these questions are answered, appropriate hardware can be selected. The following tables summarize some of the considerations in selecting the type of hardware to use.

Table 4: Hardware Evaluation

Tablet PC

Benefits	Drawbacks
Greater memory, storage, wider range of application use than PDA.	Expensive, \$3,000 plus
Can also serve as a personal computer.	Bulkier/heavier than PDA
Can operate in table mode with pen/stylus or with keyboard	Battery life is shorter
Larger screen-size than PDA	

Laptop PC

Benefits	Drawbacks
Greater memory, storage, wider range of application use than PDA.	More expensive than PDA, \$1,000 plus
Can also serve as a personal computer.	Awkward to use with keyboard on-site/in the field.
Can include CD/DVD read/write.	Bulkier/heavier than PDA
Larger screen-size than PDA	

PDA

Benefits	Drawbacks
Low cost, \$100+	Less powerful than PC
Light weight, easily portable	Small screen size

If you choose to go the PDA route, the choice must be made between Palm and Pocket PC. The respondents to the C2E2 survey were evenly split in the use of Palm versus Pocket PC. Extending functionality to include bar coding, GPS and environmental sampling is possible on either platform. Here are some considerations for each.

Table 5: PDA Comparisons

<p><i>Palm Device</i></p>	<ul style="list-style-type: none"> o Low-cost solution (\$100 - \$800) o Can install reference tools for use in the field. o Software such as Pendragon is relatively easy to use to build data collection forms. Automatically generates an MS Access database. o Can use Excel or Word with Documents to Go software (\$40-\$90) a useful add-on to view MS Office application files. o Ability to add functionality such as digital photos, video, bar coding, GPS data collection. o Will take additional software and some effort to synchronize with e-mail.
<p><i>Pocket PC</i></p>	<ul style="list-style-type: none"> o If you are building a custom solution, can build with products such as MS Access, Visual CE by SYWARE or Pocket PC Creations. o Entry cost higher than Palm devices (\$250 - \$800) o Can use MS Excel, MS Word, limited by screen size. o Out of the box integration with MS Outlook and other MS Office software. o Ability to add functionality such as digital photos, video, bar coding, GPS data collection. o Good support for wireless.

Some final thoughts on hardware selection:

- Follow your IT department’s standards.
- If there are no standards that you must follow, are you considering investing in commercial software? If you are, select the best software based on your needs, and work with the chosen vendor to select the handheld hardware that is most appropriate.
- Palm is considered easier by the less-computer literate, and more reliable. There have been complaints of Pocket PC instability (crashes).
- Pocket PC has the power and versatility of Microsoft behind them. It is better for more advanced applications using Microsoft software.
- Buy the brand and model that gives you the most memory/computing power/software that you can afford.
- Check with purchasing/IT to see if bulk discounts are available from preferred vendors.

What Software should we buy?

The best software depends on the tasks at hand, budget and standards. The market for EH&S software is vast and dynamic. While a detailed review of software options is beyond the scope of this paper, the table below presents the names and types of various software products mentioned by respondents to the C2E2 survey.

Table 6: Software

Vendor	Product	Description	Type of software
Brady Tiscor	Inspection Manager	Compliance and Inspection software. Works with Palm and PC. Reports generated from desktop.	Commercial
Symbol	Various	Bar coding, GPS, handheld software and hardware technology.	Commercial
PHE	Field Ace	Compliance and Inspection software for Palm, PocketPC and Windows Mobile 2003 PDAs.	Commercial
Vertere	ChIM	Chemical Inventory Management System	Commercial
GrayWolf	Wolfsense	Also Wolfsense IAQ (Indoor Air Quality) Air Quality sensing software - company sells probes and software that can hook the probe to a PDA; works with PDA, Tablet, Laptop and Desktop	Commercial
Q5 Systems (formerly PPM)	Q5 AIMS	Auditing Inspection Management System - for auditing and assessment	Commercial
On-site systems	EHS Assist	Tracks permitting and inspections using MS SQL database with web-based interface. Runs on Pocket PC and synced to desktops	Commercial
	FireProof Manager	Supports fire equipment inspections	Commercial
Dakota Decision Support Software	Dakota Auditor	Expert-system software to support regulatory compliance auditing.	Commercial
Crescent Software Group	Designer Suite	Customized data collection	Commercial/ Vendor
Pendragon Software	Pendragon Forms	Develop data collection forms for Palm PDAs, store in MS Access.	Development
Syware	Visual CE	Develop data collection forms for Pocket PC PDAs and store in MS Access database.	Development
Pocket PC Creations	Pocket PC Creations	Develop Pocket PC applications	Development
Dataviz	Documents to Go	Enables use of Word, Excel and PowerPoint files on PDA.	Development
Oracle	Oracle	Database software	Development
Microsoft	Office	Database, spreadsheet and word processing software	Development
Microsoft	Visual Studio .NET	Application development software	Development
Appforge	Crossfire	Enables Visual Studio.NET development on PDAs.	Development

What about Training?

Training is an important and often overlooked element of a handheld project. The extent and length of training should be driven by two factors, the complexity of the application and end users' comfort with technology and process changes. If formal training is not available from vendors, it can be developed in-house or provided by consultants, depending on skills and resources available. It is important to not overlook

this aspect because lack of knowledge about how to use the system could impact data quality and marginalize the investment made in the system's development.

Check and Act Stage



As discussed earlier, a project's lifecycle is process of continuous improvement. Once a system is built, it must be tested by end-users to validate that it meets requirements and adds value to the business process. It may be the case that some system changes are identified and addressed at this point. There should be continuous communications and feedback between end-users of the system and those developing the system to ensure that the functional requirements are being met.

Once technical and functional issues are addressed, the system is ready to be implemented. Full implementation implies the replacement of prior methods of data collection and management with handheld technology.

As use of the system becomes part of normal EH&S operations, it is important to continuously evaluate the business processes and the supporting technology and staff to identify new opportunities for improvement. This can be as simple as adding a new feature to an existing system or expanding the use of technology to additional staff, or can extend to developing functionality to support additional tasks.

It is also advisable to keep track of changes and the benefits associated with the implementation of handheld technology. This provides a valuable foundation when considering expanding functionality and can be important in obtaining financial or staff resources to support new initiatives.

Conclusions

Experiences at colleges and universities across the country indicate that handheld technology is becoming an important tool for many EH&S departments in information collection, management and dissemination. The key to success is identifying goals at the appropriate level of technological sophistication based on your specific business process, staff, financial and IT resources. Benefits can be gained even with small steps. By continuously considering how technology can support EH&S operations, small initiatives can grow appropriately to meet broader institutional needs. The Case Studies in the next section demonstrate the variety of approaches that have been taken by peer institutions.

Scenarios and Case Studies

Get Started Scenarios

For those institutions with small budgets and no formal IT support it is important not to get overwhelmed by the decisions that need to be made, especially with respect to hardware and software. A small investment in hardware and software can go a long way, and provide the experience needed to build system functionality over time. This section presents two scenarios for departments looking to get started.

Scenario A: Quick start with minimal resources

Size of EHS Department	Budget	IT Resources	Goals
Small	<\$2,500	None	Get started with reference programs and basic data collection.

Hardware:	Low cost PDA hardware such as a Palm Pilot. Desktop PC with database software such as MS Access to load handheld data. PC should have CD burner or other mechanism to backup data.
Software:	Free reference tools such as NIOSH Pocket Guide Consider Documents to Go to edit MS Word and Excel documents Consider Pendragon to build data collection forms with MS Access database
Staff:	Contact IT Department for input on standards, potential resources Consider using students or EH&S Staff
Processes:	Consider starting with simple processes whose data would be valuable in electronic form, and processes that require frequent reference lookups. Develop metrics and track benefits for using handhelds to build case for expansion of use and secure budget.

Scenario B: Starting with few resources with plans to expand capabilities in future

Size of EHS Department	Budget	IT Resources	Goals
Small	<\$2,500	None	Start with basic reference programs and data collection, but plan to expand to more advanced functions.

Hardware:	Look into higher-end PDA hardware; buy the best you can afford. Palm or Pocket PC is appropriate. Desktop PC with database software such as MS Access to load handheld data. PC should have CD burner or other mechanism to backup data.
Software:	Free reference tools such as NIOSH Pocket Guide Word and Excel run native on Pocket PC Forms building on Pocket PC with Visual CE or Pocket PC Creations.
Staff:	Contact IT Department for input on standards, potential resource Consider using students or EH&S staff. Contact hardware vendors to explore needs for bar coding.
Processes:	Start with simple processes whose data would be valuable in electronic form, and processes that require frequent reference lookups. Develop metrics and track benefits for using handhelds to build case for expansion of use and secure budget.

Case Studies

The information presented in this paper is meant to provide a methodology in moving forward with the use of handheld technology. Each institution has its own strengths and goals, and there is no one size fits all solution. This section presents some case studies of what is being done by peers across the country. We hope to update these summaries on a regular basis, so please send your summary to Tom Balf at tbalf@c2e2.org if you would like to be included in the update.

Rhode Island School of Design

Size of EHS Department	Campus Size	Campus Population	IT Support	Budget
2	50 buildings 1.2 million sq.ft.	3,000	None	Under \$2,500

Hardware:	1 Sony Clie (Palm) - Selected for low cost and ease of use
Software:	Documents to Go with Excel
Process:	Performing Inspections
System Description:	Documents to Go used to create Excel file on PDA. Inspector fills out information in Excel PDA and then syncs back to desktop in office.
Outputs:	Paper print outs of the excel spreadsheets for inspections.
Users:	Inspector and Director.
Figure 3 location:	Lower left corner

Northern Illinois University

Size of EHS Department	Campus Size	Campus Population	IT Support	Budget
10	100 Buildings	30,000	None	\$2,500-\$10,000

Hardware:	HP iPAQ Pocket Pcs and Dell Laptop – Running into limitations of storage size on iPAQs.
Software:	GrayWolf – WolfSense, Salus (for info on hood) MS Word for compliance Audits – putting forms onto PDA
Process:	Carrying reference programs such as NIOSH's Pocket Guide to Chemical Hazards or DOT's Emergency Response Guidebook 2000 Conducting compliance audits Performing inspections Accessing emergency response information
System Description:	Data entry into PDA and download to desktop. Reports generated from desktop. Access contact information for labs, types of chemicals in labs, downloading emergency data from CD Rom – MSDS sheets.
Outputs:	Reports done with MS Word for lab inspection reporting, radiation surveys, and swipe tests.
Users:	2 EH&S staff
Figure 3 location:	Lower left corner

New Mexico State University

Size of EHS Department	Campus Size	Campus Population	IT Support	Budget
10	480 Buildings 1.5 million sq.ft.	15,000	None	\$2,500-\$10,000

Hardware:	1 Palm PDA and one Tablet PC with wireless connection. Planning on replacing Palm with HP Jordano.
Software:	PHE Field Ace Software
Process:	<ul style="list-style-type: none"> • Conducting compliance audits • Performing inspections
System Description:	Data collected on PDA and Tablet PC running Windows XP with a wireless connection. Inspections are pre-planned and scheduled. Users download inspection data to the PDA and then upload completed inspection forms to the Tablet PC. Reports printed off PC.
Outputs:	Printed from desktop and saved as PDF files.
Users:	Student inspectors.
Other info:	Used familiar vendor who was able to meet university procurement regulations. Procured a “system” that included the software and hardware.
Figure 3 location:	Lower left corner

Boston University

Size of EHS Department	Campus Size	Campus Population	IT Support	Budget
32	400 Buildings 14 million sq.ft.	35,000	Informal, started with students	\$25,000-\$50,000

Hardware:	Palm PDAs
Software:	Pendragon, MS Access. Visual Studio.NET for web functionality
Process:	Inspections (Lab safety, eye wash, safety shower, drench hose, confined space) Inventory (Eye wash, safety shower, drench hose, confined space) Medical Center Compliance Rounds Indoor air quality surveys Access reference programs
System Description:	Data collected on Palm devices and synced to central database (MS Access and SQL Server) on Windows PC. Air sampling data collected and entered into PDA (temperature, CO, CO2, particulates, air velocity, humidity).
Outputs:	Reports from central database. Data available thru web browser to generate and modify reports on-line. Can create as .PDF and email.
Users:	20 EH&S staff
Figure 3 location:	Lower left corner.

Cornell University

Size of EHS Department	Campus Size	Campus Population	IT Support	Budget
63	254 Buildings 18 million sq.ft.	30,000	2 IT staff in EH&S	Started small and has grown

Hardware:	Both Palm-based (Tiscor) & PocketPC (mostly Dell)
Software:	Tiscor software, Pocket PC Creations, MS Office software
Process:	Carrying reference programs Inventory Waste Disposal Conducting compliance audits Inspections (buildings, labs, fume hoods) Accident Investigations Checklists Emergency Response Sprinkler system and fire extinguisher records (Palm) Safety and eye wash inspections (Palm)
System Description:	Pocket PC Creations used to develop custom application for inspections, including photographs and voice recordings. Data synchronized to desktops for quality control and addition of notes from recordings. Final data stored in central MS Access database for analysis and reporting.
Outputs:	Reports done with MS Access.
Users:	7 inspectors using Pocket PC and 7 inspectors using Palm/Tiscor.
Other info:	Inspectors trained in the basics of the PC Creations environment to alter the forms to meet their requirements. IT staff focus on database and reporting.
Figure 3 location:	Started in lower left and moved to middle.

University of Utah

Size of EHS Department	Campus Size	Campus Population	IT Support	Budget
19	300 Buildings 10 million sq.ft.	47,000	Have 1 IT staff within EH&S	\$7,000 (hardware and software)

Hardware:	Palm PDAs
Software:	Tiscor, MS Access (.NET, Oracle application currently being developed)
Process:	Fire equipment inspections
System Description:	Palm devices used to collect data and synced with Desktop Tiscor software used for fire equipment inspection Currently developing .NET application on top of Oracle database for in house chemical inventory, Lab inspection and compliance audits. <i>(this is not represented in budget above)</i>
Outputs:	Reports done with from desktop.
Users:	EH&S inspection staff
Figure 3 location:	Started in lower left corner and moving to middle

University of Kansas

Size of EHS Department	Campus Size	Campus Population	IT Support	Budget
10	171 Buildings 10 million sq.ft.	35,000		\$25,000 to \$50,000

Hardware:	PocketPC (mostly HP iPAQ)
Software:	Wolfsense, Omni Lock, Onsite
Process:	Air quality monitoring Laboratory Access Permit management Conducting compliance audits Accessing emergency response information
System Description: (Please fix bullets)	Various software packages working to accomplish different goals: Users of PocketPCs routinely sync with MSOutlook for scheduling WolfSense on PocketPCs connected to probes for air quality readings. OmniLock software manages access to labs on Pocket Pcs. Use infrared to download information from each lock and load to desktop. EHSAssist by Onsite Systems used for permitting. Considering EHSAssist with Pocket PC for inspections. University's IT department is currently building a custom application with an Oracle back end and Web front end to track asbestos and lead paint
Outputs:	Reports done with from desktop.
Users:	2 EH&S staff using Wolfsense and 3 using Onsite.
Figure 3 location:	Middle

University of North Carolina

Size of EHS Department	Campus Size	Campus Population	IT Support	Budget
43.5	13 million sq.ft.	36,000	High (3 FTE)	High

Hardware:	Tablet PCs – Selected for screen size, familiarity of interface, and to comply with University standard for operating system.
Software:	Custom Oracle application with Visual Basic interface, JAVA applets
Process:	Performing Inspections Access every database in EHS
System Description:	Data entry on Tablet PC for inspections, automatic generation of letters and reports. Integration with University's Human Resources database and Facilities databases for room diagrams of fume hoods and other assets.
Outputs:	Custom reports with Crystal Reports software.
Users:	3, will grow to 12
Figure 3 location:	Upper right

Harvard University

Size of EHS Department	Campus Size	Campus Population	IT Support	Budget
30	500 buildings	35,000	Formal in-house support and vendor	\$45,000

Hardware:	6 Palm Pilots – selected for low cost. May be changing to PocketPC due to University standardization.
Software:	Palm Software; Pendragon, VB, MS Access, Crystal Reports, working on Oracle database for EHS.
Process:	Performing inspections (hazardous waste, ergonomics, all assessments or inspections)
System Description:	Data entry on Palm Pilot. Integrate with digital photos. In the process of integrating with Harvard Planning and Real estate for properties list, and creating core Oracle database for EHS department. Will link from Palm to core database.
Outputs:	Custom reports with Crystal Reports software.
Users:	4 users
Figure 3 location:	Started in lower left corner and moving to upper right.

Glossary:

EH&S – Environmental Health and Safety

EIMS – Environmental Information Management System. A type of software commonly used by EH&S departments to manage environmental data including compliance and permits.

ERP – Enterprise Resource Planning. A type of software commonly used by large institutions and companies to integrate data management across departments.

GPS – Global Positioning System. A technology that captures the longitude and latitude of specific locations.

Handheld – for the purposes of this paper, handhelds include personal digital assistants, laptops and tablet PCs.

IT – Information Technology

NIOSH – National Institute for Occupational Safety and Health.

Palm – an operating system for personal digital assistants.

PDA – Personal digital assistant.

PocketPC – a Microsoft operating system for personal digital assistants.

UPS – Uninterruptible power supply.

References:

“Improving Efficiency with Pocket PC Database Software”, Frank Yacano and Rich Hall, Pocket PC Magazine, March 2001

“Mobile Computing: Palm vs. Pocket PC: The products are different, but also the same. How to choose?” James Martin, PC World, August 21, 2003.

“Pocket PC vs. Palm: What is the Right Choice?”, Steve Milroy, Windows & .NET Magazine, May 16, 2002.

On-line Resources:

www.aihaaps.ca/palm/palm.html

www.hsewebdepot.org/imstool/GEMI.nsf/WEBDocs/Introduction?OpenDocument

www.pdabuyersguide.com

www.pocketpcmag.com