A New Look
into
Portable Electronic Devices
for
Field Data Collection
in the
National Agricultural Statistics Service

by

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Appendix A

1.0 Introduction

The National Agricultural Statistics Service (NASS) is constantly looking for ways to improve its business practices to gain efficiencies in data collection and improve the quality of its data products. Today, laptops are no longer the only option in the portable electronic devices (PEDs) market. Portable Digital Assistants (PDAs), tablet PCs, Web pads, slates, convertibles and smart phones are all becoming more prevalent in society and are being used by private companies and government agencies for daily business and/or data collection. Concurrently, prices of these devices are dropping, even as the devices are becoming more powerful.

This document focuses on the four primary portable electronic device platforms available for data collection: PDAs, tablet PCs, convertibles, and laptops. Finally, each platform is looked at how it could be used within NASS' organization, the cost of implementation, and the positive/negative return on investment of each platform.

2.0 Early Research

NASS has a history of research into the use of portable electronic devices in data collection. In the late 1980's and early 1990's, computer assisted personal interview (CAPI) research projects took place and proved that data could be successfully collected using laptop computers and transmitted to a central location for further processing. However, several barriers prevented adoption of this technology for our operational program. Among these were battery life, data transmission speeds, cost of the laptops, and a limited number of field enumerated surveys.

3.0 Why Look at Portable Electronic Devices Now?

Technological improvements over the years have reduced many of the barriers that occurred with CAPI. Data transmission speed has improved significantly. Battery life has also improved to a degree. Lower cost devices, such as personal digital assistants (PDAs), are now widely available and have potential for data collection. The Agency's business model has expanded since NASS conducted CAPI research. In addition to the Objective Yield Survey Program, NASS has several large field enumerated projects: the Agricultural Resource Management Survey (ARMS); Conservation Effects Assessment Program (CEAP); and the June Area Survey that stand to increase the potential benefit of PEDs.

In the last couple of years, NASS has had success in using portable electronic

devices for field data collection. In 2002, the North Carolina State Statistical Office successfully used PDAs to collect data from State Fair attendees. In December, 2003, a pilot project was successfully conducted by Research and Development Division (RDD), Iowa State University and the Iowa State Statistical Office which demonstrated the use of tablet PCs to draw-off tract and field boundaries on June Area Survey digital maps. The motivation behind this research was an anticipated jump in the cost of printed aerial photography. A limited amount of data were also collected to simulate a portion of the June Area questionnaire.

Finally, with the increasing use of caller id by the general public to screen telephone calls and implementation of the "Do NOT Call List", combined with the bad publicity that telemarketing companies have been receiving, enumeration by telephone may become increasingly difficult to obtain enough quality data to make accurate estimates. This could mean that enumeration may shift more to the field where the completion rate is higher but at the same time so are the costs.

Hence, the timing is ripe to re-visit the use of portable electronic devices for data collection.

4.0 Portable Electronic Devices Platforms

Currently, there are four main PED platforms: Personal Digital Assistants (PDAs), Tablet PCs, Convertibles, and Laptops.

The PED platform that is selected must meet some general criteria for NASS' needs. All platforms examined have the ability to collect data and later transmit data through a modem.

4.1 PED Factors to Consider

- Portability - Capability to be used virtually anywhere. The ability to hold the device and input data into it.

- Size - Too big and the enumerator will not be able to hold and use the device properly. Conversely, too small and the enumerators may lose them.

- Weight - Too heavy and the enumerator will get tired of holding the device.

- Battery Life - With the proper training on battery management, all devices have enough battery life to last a working day.

- Processor - Need a large enough processor to handle the elaborate questionnaires that will be placed on the devices and run any edit checks as well.

- Memory - Need enough memory to bring up the various screens of a questionnaire and process the data

quickly.

- Storage - Capacity to hold questionnaires, samples and collected data.

- Ruggedness - How long will these devices hold up to the daily rigor of a field enumerator? Enumerators work in cold and hot climates, dirty, dusty, and rainy weather. Ideally, NASS should investigate ruggedized PEDs but with the cost of ruggedized devices being 40% to 200% higher than the standard PEDs, a positive return on investment is nearly impossible. Therefore, NASS should look at "low-cost" ruggedized cases and screen protectors.

- Screen size - Too small and the enumerator will be scrolling both horizontally and vertically. Too big and the device itself becomes unwieldy.

- Input method of data - Varies with the platform chosen (keyboard, mouse, pen, stylus, etc.).

- Security - Two issues: security of the device, itself, and security of the data collected and transmitted.

- Transmission method - Ability to transmit data via a telephone modem.

- Warranty - How long are the products warranted for and what is the expected life expectancy?

- Manufacturers of the product - How many manufacturers are there that produce these devices? Is the market dwindling for these devices? Will the company that NASS purchases from be around?

- Ability to be used both indoors and outside as well as during the day or night. Our current method of paper and pencil is highly flexible and the PED needs to provide the same or more flexibility.

4.2 Personal Digital Assistants

Personal digital assistants, commonly called PDAs, allow people to keep track of appointments, read downloaded e-mail, and look up saved documents.

In general, PDAs are about 4 - 5.5 inches in length and about three inches wide and 0.5 to one inch in depth. The weight is around 4 to 7 ounces. This makes the devices lightweight and easy to handle. Below are two pictures of typical PDAs.

There are three primary operating systems to choose from, Palm, Pocket PC and Linux, with the latter being the least used.

The devices themselves range anywhere from $100 to $700 in price.

Life span has been forecasted at three to four years.

The major manufacturers in the Pocket PC realm are Hewlett Packard, Dell, and Toshiba. For Palm, there is primarily PalmOne. SONY, which produced the popular Clie line, has decided to drop out of the United States' PDA market at least until the end of the year.

As far as the processor, Pocket PCs advertise a 400 - 600 MHz processor. However, this is deceiving since the Pocket PCs operating system is very resource heavy lessening the actual speed obtained. However, the Palm devices typically have a slower processor but this is made up by having a very efficient operating system.

The RAM ranges from 32 MB to 128 MB.

The companies and agencies, that are using these devices for data collection, are programming their data collection instruments in either Visual Basic or C++. Although C++ has a steep learning curve, C++ appears to be the choice of most developers, since it more flexible.

4.2.1. Which Companies/Agencies are using PDAs

- United States Postal Service

The United States Postal Service purchased five hundred fifty Hewlett Packard iPAQ 3850s for inspectors to complete forms on. The company went with this product since the unit was small enough to fit in a pant/coat pocket and could be used on a ladder or a confined area.

- Center for Survey Research - University of Massachusetts

The Center for Survey Research used both the Hewlett Packard's Jornada and the Palm Pilot III. They found that the Jornada had a nice bright color screen and some Microsoft compatible software. However, they had to program their data collection instrument from scratch since they could not find any off-the-shelf software that would suffice. Later, they found out about a program called "Pendragon". This is a Palm application which builds a variety of data collection forms. If they were going to conduct a PDA data collection project again, they would recommend the Palm over the Hewlett Packard in order to use the Pendragon software.

Contact person is Lois Biener, Ph.D.

- Natural Resources Conservation Service

The Natural Resources Conservation Service, (NRCS), used Apple Newtons for their field data collection. NRCS is in the process of moving to Pocket PCs.

Contact is Bob Dayton with Iowa State University and he can be reached at (515) 294-7789.

- National Opinion Research Center

The National Opinion Research Center conducted a study in 2000 and decided on the Pocket PC platform since this line of PDAs seemed to be more powerful and had more accessories available. They decided to go with HP's iPAQ 3650. Their testing revealed that the device was best for short interviews and that to accommodate lengthier questionnaires, laptops or tablets would still be needed.

Contact is Debashish Bagchi and he can be reached at (312) 759-4280.

- Center for Plant Health and Technologies - (USDA)

In the work place, Palm 505s are prevalent and are being used as organizers. Blackberrys are also being used for those that want to access their Lotus Notes' e-mail realtime. For data collection, they are using various iPAQ models. Their field people actually conducted a study similar to NASS' Objective Yield Survey. In NASS's Objective Yield Survey, the field person is interested in examining selected plants in a crop field, whereas, the Center for Plant Health and Technologies' field person is interested in a selected tree in a forest. On the initial visit the field person locates a particular tree based on sampling rules and ties a ribbon around it for a visual marker. The field person then records his/her findings and the coordinates using a GPS accessory called Pocket CoPilot. The field person will then use an in-house developed software called Iris to record data. The next time the field person needs to return to the same tree, he/she uses Pocket CoPilot to get fairly close and then looks for the tree with the ribbon around it.

Contact person is Corina McArthur and she can be reached at (919)-513-5071.

- United States Air Force

The United States Air Force use Palm 515m PDAs to keep track of visitors coming and leaving the Wright Air Force Base. Guards stationed at the entrance and exit gates record where the person needs to go on the base and, using the infrared feature of the device, beams the information to a nearby printer that prints

out step-by-step directions to the area of interest.

Another use of these devices is to record the daily practice sessions of bomb and drug sniffing dogs. This eliminates the need to record the practices on paper and then key all of the data in. The estimated total cost, so far, is $100,000. This includes the amount paid to a contractor for writing the software and for 70 Palm 515m's. The USAF decided on the Palm units for their longer battery life.

Information provided by the Government Computer News - 12.15.03 Edition.

- United States Census Bureau

Recently, the Census Bureau purchased 1,000 iPAQ 3950s at a cost of $750 each to conduct a 2004 Census test. The price included a case, car automobile charger, and a telephone modem.

The study should begin in the next couple of months. Interviews are expected to be 5-10 minutes in length. The questionnaire is simplistic with questions using radio buttons, drop downs, and a limited amount of numeric input. Skip logic was also used, so that only the questions of interest would appear.

Contact is Sandy Dyer of the United States Census Bureau and she can be reached at (301) 763-7827.

- Research Triangle Institute (RTI)

RTI has used Hewlett Packard's iPAQ 3950s and 4155s for data collection. In general, RTI uses PDAs for short interviews (5-8 minutes).

One study, presented at the 2004 FedCasic Conference, had enumerators equipped with a laptop along with the iPAQ 4155. The interviewer used the iPAQ as a screening device to conduct the initial interview at a person's door step. Next, depending on the respondent's answers, a more in-depth interview is conducted inside with a laptop. RTI did investigate using the tablet PC but their field enumerators overwhelmingly preferred the PDA and laptop combination.

Contact is Marty Meyer of Research Triangle Institute.

4.2.2 Conclusion on PDAs

PDAs are being used successfully by companies and other government agencies for field data collection.

PDAs appear to be best suited for short surveys, yes/no questions, multiple choice questions, and some questions that require numeric input. The length of the interview tends to be less than ten minutes.

The small size and light weight of the PDA

is a perfect fit for field enumeration, especially when a enumerator has to physically go into a farmer's field and record data.

However, a PDA is not like having a desktop computer with you. The storage, memory, and processors on these devices are minimal.

Also, a majority of NASS' field enumerated questionnaires contain tables which, while not impossible to put on a PDA, would require substantial vertical and horizontal scrolling for the enumerator due to the PDA's small screen size. Also, the enumerator's inability to see all of the columns may increase his/her chances of some columns being missed during the interview.

A table, however, is simply a series of individual questions and thus these individual questions could be put onto a PDA to emulate a paper questionnaire. This may increase the perceived length of the interview significantly and would require developing a question for each item in the table.

In addition, the PDA's small screen size is not practical for displaying a June Aerial digital map. The amount of scrolling and zooming would be very laborious and has the potential to increase recording errors.

Currently, private companies and agencies use the devices for only short interviews (under 10 minutes) which is well below the length of an average ARMS Phase 3 - Version 1 interview (94 minutes) or the average length of a CEAP interview, (64 minutes). NASS currently does not track the amount of time each field enumerator takes to complete each field enumerated survey. Hence, it is with speculation that an average field interview is significantly longer than 10 minutes.

Another drawback is that telephone modems would have to be purchased to enable these devices to send the collected data back to the data collection center. This accessory adds an additional $80 to the cost of the device. One aspect to keep in mind is that not all PDAs accept a modem.

Also, suggested is a car charger for the PDA just in case the battery gets low in the field.

By using the costs obtained by the Census Bureau, the projected cost for NASS is from $600 to $800 per device. This includes the accessories noted above.

Note: *A NASS pilot study on using PDAs to collect Cotton Objective Yield data is currently underway in the North Carolina State Statistical Office. This pilot is expected to shed some more light on using PDAs for data collection, as well as*

provide insight on the benefits and cost of using PDAs.

4.3 Tablet PCs

Tablet PCs came into the spotlight in 2000. Microsoft has made alliances with several of the small tablet manufacturers that are able to market their products with the Microsoft name as long as they follow a set of general specifications provided by Microsoft. Since this is a new industry with many small manufacturers bidding for customers and market share, it is still too early to tell which manufacturers will be around. The major tablet PC manufacturers are Fujitsu, Toshiba, Hewlett Packard and Motion.

Typically, a tablet PC is like a flat screen monitor (without the stand) that contains a computer within.

Overall, tablet PCs generally weigh about 3.0 to 3.5 pounds. Tablet PCs typically have a 1 GHz Intel Pentium or Centrino Processor, a 30 - 40 Gigabyte hard drive, and 256 - 512 Megabytes of memory. Screen size varies from 10-12 inches. Windows XP - Tablet Edition is the operating system. Price ranges from $1,500 to $2,000 per unit.

The primary method of using the tablet PC is via a special pen. The tablets have handwriting recognition software that allows one to actually write in the answer, which the computer will recognize as text or numbers, etc.

A second way to enter information is to use a keyboard that appears as part of the screen. This on-screen keyboard is operated with the tablet's pen.

Finally, it is also possible to use an external keyboard and mouse for data entry and navigation.

Most tablet PCs are designed for viewing either indoors or outdoors, but not both. This presents a problem for enumerators, since interviews can take place either indoors or outside. However, in response

to customers' demand for indoor/outdoor screens, Fujitsu produced the first multi-use tablet PC. Motion followed with their own model in the summer of 2004. NASS has used both of these models and found that neither device is easily readable in direct sunlight.

4.3.1 Which Companies/Agencies are using Tablet PCs

- Westat

Westat uses tablet PCs to conduct their National Health and Nutrition Survey. Originally, paper questionnaires were used. However, the screening questions and branching became so complex that a computer became necessary to figure out what questions were to be asked.

Originally, Westat looked at PDAs, however, the small screen size and the limited amount of data that these devices could hold did not make them feasible. Hence, tablet PCs were examined and were found to meet Westat's needs. Westat decided on Fujitsu's model 1200. The devices have lasted 6 years with an overall failure rate of 3 to 5% per year.

The initial interview is conducted at the door step and then, depending on the respondent's answers to the screening questions, a more extensive interview is conducted indoors using an external keyboard with the tablet PC.

Westat found that battery life was a problem with batteries lasting only 2-3 hours.

The survey instrument primarily consisted of radio button type questions. The size of the radio buttons were increased so their field people could clearly see them.

Westat did have some problems with data transmission in that sometimes they would receive duplicate data.

Overall, they feel that the devices have held up to the rigors of field data collection (light rain, heat, and cold).

Westat also conducted a study where the data collection environment was on the beach. The study asked beach goers questions pertaining to health and sun exposure.

Realizing that a significant amount of interviews were going to be conducted in direct sunlight, Westat designed their electronic questionnaire to have black text on a white background. They realized through testing that using other colors made visibility difficult. During enumeration, field staff tried to conduct their interview in the shade where possible. However, some interviews were able to be conducted in full sun.

Westat was also impressed that the devices did survive the hostile

environment of heat, sand, and salt air.

Westat's future plan is to replace their current tablets with new ones and they will probably decide on Fujitsu' 4100 series. The total number of field enumerators with tablets is 35.

Contact person is David Hill of Westat and he can be reached at (301) 251-1500.

- URS Corporation

URS Corporation is contracted by the Federal Emergency Management Agency (FEMA) to conduct interviews on those households across the United States that file for disaster relief.

Example: If a hurricane does significant damage to a county and the area is declared a federal disaster area, homeowners request an application for disaster relief to help pay for repair costs. URS Corporation's role is to go out and complete the application with the homeowner within 72 hours of the initial request.

Typically, URS Corporation has 20 to 25 full time field staff who fly across the country to disaster areas. Depending on the size of the disaster, up to 1500 reservists can be called upon for assistance. If these reservists are activated, then a short training session would occur.

URS Corporation decided on Fujitsu's tablet PCs. Of the fifteen hundred used, twelve hundred of the tablets are Fujitsu's model 3400 and the remaining three hundred are Fujitsu's model 3500.

Loaded onto the tablet PCs is Microsoft's Streets & Trips software, which allows field staff to get a rough approximation on the location that is needed to be reached.

Interviews are conducted either inside or outside. Their field staff use the built in telephone modem to transmit the completed applications to FEMA.

There are two support staff (located in Fairfax, VA) that are responsible for receiving any broken Fujitsu's and sending a replacement to the field person immediately. These two employees are also responsible for making any repairs if possible or sending the product back to Fujitsu for warranty work.

At the present time, the contract with FEMA will be expiring and URS Corporation is looking to win the contract again. If successful, they will upgrade their current tablet PCs with Fujitsu's newer models.

Contact person is Ed Hagarty of FEMA and he can be reached at (703) 849-0289.

- United States Census Bureau

The United States Census Bureau has researched and purchased several models of tablet PCs and have put them through various testing. However, at this time no additional funding has been approved for using tablet PCs in the field.

Contact person is Mike Haas and he can be reached at (301) 763-7832.

- United States Department of Labor - Bureau of Labor Statistics

The Bureau of Labor Statistics (BLS) is moving from using laptop computers to tablet PCs for data collection. BLS currently has 400 field personnel with Fujitsu tablet PCs for data collection. These field personnel typically conduct 6 to 8 one-hour interviews a day. Interviews are conducted in a residence or at a place of business. Each field personnel has been provided an extra battery and a car charger. A Help Desk, staffed with 9 people, was created to handle the various hardware and software issues. The questionnaires are developed in Visual Basic and the tablet PC is locked in the sense that no other programs can be loaded onto the machine by the field personnel. This keeps every machine configured the same and makes things easier for the Help Desk personnel in troubleshooting problems.

Overall, by using portable electronic devices for data collection, BLS statisticians are able to gain access to the data quicker and the quality of the data is better since simple edit checks are built into the electronic questionnaires. Also, BLS no longer has a problem of losing questionnaires in the mail.

BLS found that using portable electronic devices did not reduce the interview length. However, savings in time were realized since field personnel no longer had to go to the post office to mail their completed questionnaires back to the office. Also, the time taken to organize all of their paper questionnaires was eliminated.

Staffing costs were basically a wash, since the data entry staff had to be replaced with staff for a Help Desk.

BLS is also seeing that as the field personnel become more accustomed to using the devices that the breakage rate due to accidental drops have increased.

Contact is Jane Martinez and she can be reached at 202-691-5814.

4.3.2 Conclusion on Tablet PCs

Using a tablet PC is like having an average desktop computer out in the field. As shown by Westat, Bureau of Labor Statistics, and URS Corporation, tablet

PCs can be successfully used for field data collection.

The screen size (10 to 12 inches) allows a typical page of a paper questionnaire to be displayed with minimal horizontal and vertical scrolling.

The 30-40 gigabyte hard drive allows the device to hold multiple questionnaires, data sets, samples, and even training materials.

Most models have a built in telephone modem. Hence, the only additional accessories would be a back-up battery and perhaps a ruggedized case to provide the device extra protection from the every day knocks of field enumeration. This would add an additional $200 to the overall cost of the unit.

In November 2003, NASS conducted a field study with six Gateway tablet PCs. The study showed that digital maps for the June Area Survey could be placed on the device and that the enumerators were able to draw off the various tracts and field boundaries.

During the study, the Gateway tablet PCs' screens were practically unrecognizable in direct sunlight, thereby rendering the devices useless. A Fujitsu tablet PC, that was rated for indoor/outdoor use was also tested. This unit was only marginally better than the Gateways. Also, the Fujitsu tablet PC required a screen protector to be used which distorted the screen's images. Removing the screen protector eliminated the distortion but allowed the screen to be easily scratched from users pressing too hard with the pen. Gateway tablet PCs do not require screen protectors and scratching from pressing too hard with the pen did not occur.

Handwriting recognition, although vastly improved from a few years ago, still needs to be improved for NASS' needs.

Overall, tablet PCs need to improve in the areas of screen visibility and handwriting recognition. Price is also a major stumbling block for these devices. To equip an enumerator with a tablet PC, ruggedized case and an extra battery costs from $1,900 to $2,300 per unit. Field testing of the tablet PC may show that an auto adapter/charger for the laptop may be needed. This would add $90 to the overall cost.

4.4 Laptops

Laptops were the original portable electronic device and have been out on the market the longest.

Devices range in size from less than an inch to 2 inches thick, 11 to 14 inches in width, and 9 to 11 inches in depth.

Laptops are by far the most powerful PED on the market. A standard laptop has a 1.0 GHz to 3.0+ GHz processor, 256 MB to 512 MB of memory, and a 30-60 GB hard drive. The operating system is typically Windows XP. Hence, laptops are comparable to a standard desk top computer. Prices of these devices range from $700 to over $2,600.

For field data collection, overall weight of the unit can be an issue. Some of the lower priced laptops weigh 8 to over 9 pounds. However, for $1,600 one can purchase Dell's Inspiron 300M which weighs in at slightly less than 3 pounds. For $1,400, one can purchase Dell's Inspiron 600M which weighs in at 5 pounds.

This platform does provide the functionality of a keyboard and touch pad.

Screens size ranges from 12 to 17 inches. A telephone modem is standard equipment.

4.4.1 Which Companies/Agencies are using Laptops

- United States Census Bureau

Laptops have been used for data collection for over 15 years by the United States Census Bureau.

The Census Bureau is a high volume user of laptops for data collection. Recently, they purchased 10,000 Dell laptops for their 7,000 field interviewers. The extra laptops are for developers, office staff, and replacements. Field interviewers are also provided with several extra batteries and a laptop case.

Most of the interviews are conducted at residents or businesses and either indoors or at the door step. Interviews last anywhere from 5 minutes to over 3 hours. Interviewers have also created their own straps and harnesses to hold the laptop while standing. Each field interviewer is also supplied with a return kit which is basically a box with special packaging designed for the interviewer to return a broken laptop and any peripherals to the repair center. At the same time, a new laptop with peripherals is sent to the interviewer. This replacement process occurs on those surveys that are under a tight time constraint (10 days).

The questionnaires are developed in Blaise and CASES.

The Census Bureau estimates the laptops to last 3-4 years. They have also learned that it is best to have the same type and model in the field. This simplified the Help Desk's task in troubleshooting any problems.

Contact person is Rick Bitzer and he can be reached at 301-763-2018.

- Westat

Westat utilizes approximately 4,500 laptops in the field, depending on the number and size of projects occurring. The laptops vary by manufacturer (Toshiba, Dell and HP) and model.

Interviews range from 20 minutes to an hour. However, one study required multiple appointments and the total interview time was over 7 hours. Interviews are conducted at households and clinics.

The built in telephone modem is used to transmit data.

Westat has an extensive Information Technology infrastructure to support the laptops with up to 20 personnel manning the Help Desk.

Blaise is used to develop the questionnaires.

Contact is Ben Gill and he can reached at 301-294-3954.

- RAND Corporation

RAND Corporation has upwards of 50 laptops in the field at a time. Interviews will last anywhere from 45 minutes to 2 hours. Questionnaires are built using CASES. Sometimes Audio Computer Assisted Self Interview software (CASI) is used for those questions that pertain to sensitive data. Field personnel use the built in telephone modem to transmit data back to the office. Field personnel are supplied with extra batteries for the laptop. Field personnel also learned that a laptops' screen is unreadable in any type of rain. RAND expects the laptops to last about two years. After that time frame, the laptops start to display keyboard problems, hard disc failures, and motherboard issues.

Contact is Christopher Corey and he can be reached at 310-393-0411 Ext. 7505.

- United States Department of Labor - Bureau of Labor Statistics

The Bureau of Labor Statistics used laptops for data collection but have since switched to tablet PCs. Also, for those programs where laptops are still being used in the field, the data are first collected on paper and then later entered onto the laptop.

Contact is Jane Martinez and she can be reached at 202-691-7410.

- Research Triangle Institute

Research Triangle Institute uses laptops for data collection for some of their surveys. Interviews are conducted initially at a person's door step and, depending on the person's responses, a more in-depth interview is conducted inside the person's residence.

Contact is Rodney Baxter and he can be reached at 919-485-5640.

4.4.2 Conclusion on Laptops

NASS proved back in the late 1980's that laptops could be used successfully for field data collection. The primary reasons for not pursuing this avenue any further was poor battery life, slow data transmission speed and cost. Laptops during those years never dropped in price. During the 1980's, laptops became more powerful but the manufacturers would add more features to the lower end models thereby keeping the price fairly level. However, during the late 1990's, the price of laptops decreased as more powerful machines became available.

Laptops are the most powerful PED platform in terms of processor, speed, and storage capacity. The screen size is also conducive to displaying an entire page of a questionnaire with only minimal scrolling.

However, using the laptop's touch pad to draw off fields and tracts on a June Area Survey's digital map would need to be researched to see how easily this could be done in comparison to the tablet PC's pen.

Also, the laptop's dimensions does not lend itself to conducting an interview standing up. A majority of field interviews involving laptops are conducted inside, where the interviewer can place the laptop down to easily key in the information. This is not to say that interviews with a laptop cannot been done standing up, but that standing places a more physical strain on an enumerator.

Hence, to equip an enumerator with a laptop and an additional battery costs approximately $1,600. Field testing would need to be done to see if an auto adapter/charger and/or a case would be needed. If so, an additional $200 per unit would be added to the overall price.

4.5 Convertibles

Convertibles are a cross between a laptop and a tablet PC. The screen and keyboard are connected together by a hinge that allows the monitor part of the tablet to flip around on top of the keyboard and become a tablet.

Convertibles provide the combined functionality of the tablet PC and the laptop since they can be easily converted to either platform.

Manufacturers typically build these devices with a processor speed around 1.4 GHz, 40-60 gigabyte hard drive, and 256 to 512 MB of memory. The typical weight is around 3.5 to 6 pounds. Screen size is around 12 inches. Prices of these devices are around $1,800 to over $2,400.

Acer, Fujitsu, Toshiba, and Viewsonic are the major manufacturers of these devices, but there are also several smaller manufacturers that produce them. However, this platform is also relatively new and the fall out of who is going to be around is still unknown.

4.5.1 Which Companies/Agencies are using Convertibles

Business people are using convertibles since it provides them with a laptop that can handle everyday work as well as a tablet for taking notes in meetings.

- Visiting Nurse Association of Central Jersey

Visiting Nurse Association of Central Jersey (VNACJ) is a non-profit home health agency providing comprehensive health care services for people. Nurses visit their patients' residences and collect information on their patients. The interviews are conducted inside and last less than an hour. The convertible was originally selected since some staff preferred to enter data via the keyboard over the pen. However, through time, most of the nurses are using the keyboard for data entry and notes. VNACJ has approximately 400 Acer Travel Mate C100s in the field and their Help Desk receives about five per day that need some sort of repair. The main repairs are replacing the clips on the side that allow the screen to open up and rotate, and replacing parts of the cases, keyboards and motherboards.

The information was obtained from VNACJ's Management Information Systems Department, (732)-224-6975.

VNACJ was the only company that I could find that is actually using convertibles for data collection that is even remotely comparable to NASS' data collection.

4.5.2 Conclusion on Convertibles

Convertibles have the benefit of entering data via a pen or the keyboard. The keyboard and touch pad come in handy when typing more than a few words.

However, with most convertibles weighing over 5 pounds, testing would have to be done to see if field enumerators could physically handle the weight. The Census Bureau's Computer Assisted Research Office, has done testing and their research showed that laptops less than 5 pounds are best for field enumeration. Testing on convertibles would need to be done to see if the same weight limit applies.

The pivoting hinge on these devices (although a great concept) continues to be a weak structural point. Most of the repair problems involve the hinge actually breaking, making the device unusable.

To equip a field enumerator with a convertible costs approximately $2,300 to $2,500 (includes an extra battery). Additionally, field testing would need to be done to see if an auto adapter/charger and/or a case would be needed. If so, an additional $200 per unit would be added to the overall price. This makes convertibles the most expensive PED on the market.

5.0 Ruggedized Portable Electronic Devices

Ruggedized versions are available for each of the platforms researched. Typically, ruggedized units are better equipped to handle most knocks/drops as well as to contend with the various weather environments that field enumerators face.

However, expect to pay an additional 40 to 200% or more. For example, a standard tablet PC that could be used by NASS' field enumerators starts at $1,899 (Fujitsu ST 4000), whereas a comparable, but fully ruggedized, tablet PC by Xplore (Model iX104 All Terrain) starts at $3,952. On the laptop side, a standard Dell laptop (Inspiron 600m) can be purchased for $1,049 compared to a ruggedized laptop from Panasonic (Toughbook CF-29) which costs $4,200 or the ruggedized version from Rough Rider which costs over $7,000.

Ruggedized versions are also heavier than their standard counterparts. This extra weight (excluding the PDA platform) will make it more difficult for enumerators to

use the units while standing for any length of time.

6.0 What about the projected high costs of the June Aerial Photos?

Within the last couple of years, there was a growing concern that the cost of aerial photos for the June Area Survey would skyrocket. Currently, the cost is $40,000 a year. (Approximately 2,500 photos are replaced each year at a cost of $16 per photo.) The projected cost was going to increase to $64 per photo which would increase Area Frames' cost to a staggering $160,000.

This lead the Area Frame Section to investigate other avenues. One possible solution was to replace the aerial photos with digital photos on a portable electronic device. Hence, a pilot study was conducted in November of 2003. The pilot showed that digital maps for the June Area Survey could be placed on a tablet PC. The pilot also demonstrated that enumerators could actually use the device to draw off tracts and fields.

However, in December 2003, the Area Frame Section continued investigating more options to reduce costs and found and implemented a cost effective alternative to purchasing aerial photos. The section purchased a high-end plotter to print their own photos and have found a source (Terra Server) to obtain the maps already in digital format. Without sacrificing quality, the cost has been reduced to $10 per photo (this includes ink, printer costs, paper costs, etc.).

Terra Server provides its digital maps for free. Hence, the ability to use PEDs for the June Area Survey has the potential to save the Research and Development Division's Area Frame Section at most $25,000 a year.

7.0 Which of NASS' questionnaires could be used on a portable electronic device?

Theoretically, all of NASS' surveys could be conducted on a portable electronic device. However, as discussed earlier, the PDA's small screen size makes the device impractical to display any questionnaire containing a table, which most questionnaires that require personal enumeration have. Thus, the tablet PC, laptop and convertible are left as possible devices capable of handling tables.

Some of the surveys, that the majority of data is collected through personal field enumeration, are listed below.

- Agricultural Resource Study II & III
- Field Crop Chemical Use Survey
- Vegetable Chemical Use
- Post Harvest Chemical Use Survey
- June Area Survey
- Conservation Effects Assessment

Program
- Nursery and Floriculture Chemical Use Survey
- Objective Yield Program

Also, surveys similar to the Quarterly Agricultural Surveys, where personal enumeration is conducted for those operations in the higher strata, potentially could be conducted on a PED.

Some of these field enumerated questionnaires, though, would require additional programming and innovative questionnaire designing in order to display a table that spans two pages on a paper questionnaire, display a respondent booklet and provide enumerators the ability to write comments. This would require some enhancements to the Question Repository System and using some creative ways in displaying questions.

8.0 Conclusion

Each PED platform has its own unique qualities and problems. In terms of the overall cost to equip a field enumerator, the PDA is the least expensive PED at $800, followed by the laptop at $1,500, the tablet PC at $2,100 and the convertible at $2,400.

Comparing the technical capabilities (processor speed, storage, etc.) of each platform, the laptop and convertible are virtually tied, followed closely by the tablet PC, with the PDA a very distant fourth. Depending on the volume of work, the PDA is the only platform that I have serious doubts about.

Concerning size, weight, and the ability to be used in the field, first place goes to the PDA. One can use the device practically anywhere and it is easy to hold. The tablet PC is easier to hold while standing, compared to the convertible or the laptop.

The capability to be used in direct sunlight will be an issue for every platform except the PDA, whose small screen size gives it a significant advantage.

Definitely the convertible is heavier but does having a keyboard outweigh the additional weight? My feeling is yes but additional research would have to be done to substantiate this theory. All platforms except for the PDA can display an entire page of any of NASS' questionnaires without substantial scrolling. Thus, using the PDA for data collection, would require a major overhaul of our questionnaires and developing a separate question or groups of questions for each cell of a table found in most of NASS' questionnaires. Hence, the achilles heel of the PDA is its small screen size.

The ability to enter data via a pen is a definite bonus for the tablet PC, convertible and the PDA. For drawing out

tracts and fields on a digital map for the June Area Survey, the tablet PC's pen worked very well.

However, the tablet PC's pen for data entry can be a hindrance for anything beyond simple typing of numbers and a few letters. An on-screen keyboard or an external keyboard could easily handle an operation's name and address change while the pen would be very frustrating at best. Also, for data transmission, simply typing in an id and password or even a NASS site to transmit the data is very awkward with a pen alone. This is why I give the convertible high marks for also having a keyboard and touch pad as well as the pen.

Hence, my choice of a portable electronic device to handle NASS' field data collection is a toss up between the convertible and the tablet PC. These are the two most versatile PEDs, and to be at all cost effective the devices would have to be used for multiple surveys.

9.0 Where to go from here?

Hopefully, this document has provided you with a better understanding of the capabilities of each PED platform.

The question on "Where NASS should go at this point?" has three possible options.

Option 1: Full scale development and implementation of a PED data collection system.

Option 2: Conduct small scale research projects that would work towards building a pilot system.

Option 3: Re-visit PEDs in a few years.

For Options 1 and 2, the author recommends NOT using PDAs for field data collection since the PDA was found not to be a viable platform due to its limited capabilities and field applications.

Sections 10.0 - 12.0 describe each option in more detail.

10.0 Option 1 - Full Scale Development and Implementation

Develop a system that allows NASS to conduct any survey in the field via a selected PED. NASS would accomplish this by leveraging the Question Repository System and parts of the Electronic Data Reporting System, and by constructing an Internet site that would manage the transmission of data, questionnaires, field assignments, and even training. All State Statistical Offices (SSOs) would be operational with this new data collection method within 4 years. Additional details on the system are provided in **Appendix A**.

10. 1 The Benefits

This option allows NASS to have a state-of-the-art PED data collection system. There are several benefits to using PEDs for data collection. The most notable ones are provided below.

- Improved data quality. The ability to use edit checks and historical data on the PED will provide NASS with better data and in the end a better product.

- Reduce data entry costs since now the data are already in electronic format at the time of collection.

- Mailing costs of questionnaires will be reduced. No more mailing paper questionnaires back into the office. Also, field enumerators will be able to receive their assignments and questionnaires electronically.

- Data can be transmitted back to the SSOs faster and in some cases the very same day. This will provide the SSO staff more time to review the data.

- All surveys could be conducted on the device.

- Time sheets can be completed on the device. This would allow NASS to have a more accurate account of enumerator expenses.

10.2 The Drawbacks

- This is a very aggressive plan and would require a significant amount of resources in funding and staffing. At $2,000+ per unit for each field enumerator (approx. 3,000), the cost would is estimated at 6 million dollars for hardware alone on top of financing for building the infrastructure. Staffing would be needed to build the infrastructure and a support staff of 5 - 10 FTEs would also be needed once the system is fully operational.

- Return on investment is not likely due to the enormous start-up costs.

- The PEDs, themselves, are still not quite to the level that NASS' field enumerators need. As noted earlier, the ability to see the screen outside for three of the four platforms is questionable.

11.0 Option 2 - Small Scale Research Projects

Conduct small scale / low cost research projects that will work towards building the needed pieces that will create a pilot system and eventually a production system. Sub-sections (11.1 - 11.6) provide an outline for these small scale research projects.

11.1 Data Collection Instrument

The first step is to decide how a data collection instrument for a PED would be developed.

Possibilities include using Blaise, leveraging the Question Repository System, or using software like C++ or Visual Basic.

Recommend the QRS since eventually all of the questionnaires will be residing there. Blaise is an option but only 20 of NASS surveys are in Blaise. Using software like C++, is the least viable option since NASS doesn't have expertise in this software.

How would the data collection instrument be transferred onto the PED?

Propose researching how questionnaires could be transferred from the Question Repository System to any portable electronic device.

STG (contractor for NASS' Electronic Data Reporting System) provided a very basic demonstration of this on a tablet PC. The project would consist of understanding, documenting and improving upon what was done by STG. To keep costs to a minimum, one staff member of Research and Development Division (RDD) would learn the various software being used on the prototype tablet PC and attempt to replicate the process on another PED. Assistance from Information Technology Division (ITD), especially Field Services, would be needed. This would help answer the issue of how the questionnaire for the PED would be created.

In the future, investigate how to transfer the questionnaire to a PED ***remotely***.

Financing: $4,000 for training in Apache, Sybase and Perl.

Resources: 1 - RDD Staff and assistance from ITD (Field Services).

11.2 Sampling Information

Once the questionnaire is on the device, the next step is to take the operator's sampling information and place it onto the PED.

Resources: 1 - RDD Staff.

At this point, NASS would have the capability of placing a questionnaire with a sample on a PED and could actually start collecting data.

11.3 Transmission

There are two types of data transmission issues. The first is the secure transmission of the data collection instrument and sampling information onto the device. The second is secure transmission of collected data from the device to a database.

Propose one RDD staff member to research the best way to securely transmit

data quickly, accurately and securely to and from the selected PED.

This would be accomplished by researching what other companies and agencies are using for data transmission and by visiting with various vendors of data transmission software/hardware.

Next, develop a list of requirements that is needed for NASS' data transmission activities.

Finally, select the top three products that meet NASS' requirements and test sending questionnaires and mock data back and forth using one of RDD's tablet PCs and a computer acting as a database.

Financing: $1,000 for purchasing data transmission/encryption software to test.

Resources: 1 - RDD Staff, 1 - ITD Staff with input from ITD's (Computer Security Section) and NASS' Enterprise Architecture Council.

At this juncture, NASS would have the ability to place a questionnaire from the QRS along with that survey's sampling information onto a portable electronic device, collect data and finally transmit the collected data back to a remote database.

11.4 Security of the PED

What happens if the PED is stolen or lost? Can anyone get to the data?

Research what are the best ways to protect what is on the device so that non-NASS/NASDA employees can not access the data or use the device.

Propose one RDD staff member to research the best way to secure the data that resides on the device and to prevent non-NASS employees from using the device.

This would be accomplished by researching what other companies and agencies are using for security of their hardware and by visiting with various computer security vendors.

Next, develop a list of requirements that is needed to meet NASS' security requirements.

Finally, select the top two products that meet NASS' requirements and test using one of RDD's tablet PCs.

This may require assistance and consultation from ITD (Field Services & Computer Security) and NASS' Enterprise Architecture Council.

Financing: $500 for purchasing software/hardware to test. This cost may be bundled with the Transmission proposal discussed in 11.3.

11.5 Testing

Test how this PED pilot system would work in a State Statistical Office.

Propose working with a State Statistical Office (SSO) that is willing to use the selected PED for data collection. Choose a survey to test and conduct live enumeration with a handful of PEDs. This will allow NASS to learn what still needs to be fine tuned before expanding the pilot system to a true production environment. This would also provide NASS with how the selected PED would actually work in the field.

Financing: $50,000+. Purchase 10 PEDs and accessories for testing, software licensing if needed, and hardware (server), travel and training costs.

Resources: Staffing is as follows: 1 - RDD, 1 - Survey Administration Branch (SAB), 1 - ITD (Field Services), 1 - Questionnaire Design Section, SSO staff and NASDA enumerators.

11.6 Pilot to Production

Work towards transforming the pilot system to a production system.

As a starting point, I developed a plan that shows how PEDs could actually become operational within NASS' current business model. See **Appendix A** for specific details. The cost of actually doing this from scratch is not realistic but having accomplished these earlier small scale research projects, NASS has actually built a prototype of the system.

Financing: Undetermined at this time.

Resources: Minimum staffing requirements: 1 - RDD, 3 - ITD (one each from Field Services, Systems Services, and Computer Security), two from SAB and two from Questionnaire Design Section.

11.7 The Benefits of Small Scale Research

- Allows NASS to use minimal amount of financial and staffing resources.

- Provides the flexibility to build/change the system as NASS' business model changes.

- Better chance of achieving a positive return on investment since NASS can gradually develop and implement the system with minimal funding.

- Keeps NASS moving forward on using the latest technologies to obtain the most accurate data possible.

11.8 The Drawbacks of Small Scale Research

- Staff and financial costs, although small, still exist.

- Stretches out the time frame for full-scale implementation.

- Some research/findings may become obsolete by the time NASS is in a position to implement.

12.0 Option 3 - Re-visit PEDs in a few years

The other option is to re-visit PED data collection altogether. With the cost of PEDs ranging from $500 to over $2,000, maybe it is best to post-pone PEDs for another 3-4 years. During my research, I was unable to find a single data collection agency or company that could show a positive return on investment. An agency/company implemented PEDs either because they were allocated money to use PEDs or that the client insisted that a particular PED was to be used.

The main reason for postponing further PED research is that there is no immediate cost to NASS in terms of staffing or financing. A secondary reason is that no company/agency has shown a positive return on investment by using PEDs for data collection.

The primary drawback for re-visiting PEDs in a few years is that other statistical agencies will advance in data collection methods while NASS falls behind. This in turn may cause the general public to question why NASS is not using the latest data collection technologies like other agencies. A secondary drawback is that the use of PEDs for data collection will have to be re-researched, which will cost NASS in staff resources and financing.

13.0 Final Thoughts

Within the last five years, portable electronic devices have exploded with various platforms and models. PDAs, tablet PCs, laptops, and convertibles are being used by private companies and government agencies for daily business operations and/or to collect field level data. These companies/agencies, however, have not been able to overcome the high initial start up costs to show a positive return on investment.

In the future, costs will continue to come down which will make the use of PEDs in the field more feasible. Hence, cautiously approaching data collection using PEDs will enable NASS to implement PEDs when the time is right.

Appendix A

A.1 The PED Vision

Envision a NASS operated Web Site for Field Enumerators (WSFE) that an enumerator can access through the NASS Access Server via a telephone modem, cable modem, wireless modem, etc. and download his/her daily work assignment (operators of interest, questionnaires with edit logic, interviewer's manual, etc.) to a portable electronic device.

The enumerator views the list of operations to visit and at this time has two options depending on the survey.

Option 1 - Telephone Interview

Call the operator over the phone and complete the questionnaire on a PED.

Option 2 - Field Interview

Call the operator and schedule an appointment for a personal interview. Next, the field enumerator will use his/her PED and a pre-loaded transportation software to determine the most efficient path for that day's work based on the scheduled appointment times and driving time.

The field enumerator then follows the predetermined route, via an attached Global Positioning System (GPS) accessory, to the operations of interest.

The enumerator drives to the operator's location and goes through the typical NASS introductions and opening formalities to make the operator feel comfortable on completing the questionnaire.

Next, the field enumerator uses the PED to bring up the appropriate questionnaire(s), and begins the interview. The enumerator reads the questions and records the operator's responses into the device. The addition of simple edit checks would improve the quality of the data since unusual acreage, yields, expenses, and income can be noted or if invalid, corrected.

The enumerator continues working throughout the day with all of the information being captured onto the device.

Regardless of the above option selected, the field enumerator, at night, will connect to the Web Site for Field Enumerators (WSFE) via a modem (built into the PED) and upload all of the data. The next morning, the State Statistical Office (SSO) will download the data via the same process currently used by the Electronic Data Reporting System.

The WSFE would also be accessible by the SSO and the supervisory enumerator. The statistician in the SSO would use the Survey Management System (SMS) to mark those operations of interest that require field enumeration and upload this information to the WSFE. The actual questionnaires to be downloaded would be obtained from the Electronic Data Reporting (EDR) system. Next, the supervisory enumerators would access the WSFE and manage the field enumerators' assignments. This ensures that the correct operations and questionnaires are downloaded to the proper enumerator's portable electronic device.

A.2 Benefits

- Provide field collected survey data to the SSOs faster. No more waiting for the questionnaires to come in the mail or personal delivery and then have to wait for the data entry personnel to key the data. Field collected data has the potential to be processed the very same day. This would enable the survey statistician to review the data sooner.

- Enable NASS to reduce its data entry staff costs since the data will already be in electronic form.

- Improve the quality of the data since simple edit checks would be incorporated into the downloaded questionnaire. Large discrepancies in an operation's data from one quarter to the next could be displayed on the PED and the enumerator would note the reason for the discrepancy or correct the data if needed. This would reduce the number of call backs to operators that statisticians conduct when the collected data appears to be invalid.

- Field enumerators' work assignments could be easily changed. Shuffling of paper questionnaires between enumerators is eliminated. This saves enumerators and SSO staff time and in some cases mailing costs.

- Eliminate mailing questionnaires or physically transporting questionnaires to enumerators.

- Eliminate the need for enumerators mailing questionnaires back to the office or using NASS personnel to physically go and meet the enumerators to obtain the completed questionnaires.

- Facilitate the data review process. Since the collected data will be in electronic format, a statistician can look up a particular operation's survey data quicker and easier than weeding through hundreds or thousands of paper questionnaires.

- Reduce the amount of physical storage space an office needs since everything is kept electronically from the start.

- Facilitate administrative management of the data collection process. Enumerators would be able to complete their time sheets electronically. Also, by incorporating simple edit checks, accuracy of expenses would improve and eliminate any discrepancies. This would save both SSO staff and enumerators' time. This improved accuracy of expenses can then be used in deriving at better cost estimates for future reimbursable projects and thereby reducing the possibility of cost over runs.

- Improve enumerator training. The enumerator handbook, training material and training modules could also be downloaded to the device. The training would go beyond just showing the user how to operate the PED but also walk the enumerator through the questionnaire and the purpose of the survey. This could eliminate the need for some of the workshops for field enumerators.

NASS could also have the capability to see if enumerators actually reviewed the training before starting enumeration.

This would require additional staffing to make the enumerator's training material and aids available. Overall, this should help our enumerators become better educated on what they are asking and therefore should improve the quality of data being collected.

A.3 Vision to Reality

Bringing this vision to light, would require leveraging the Question Repository System and the Electronic Data Reporting System.

Currently, the Question Repository System (QRS) is operational and contains approximately thirty surveys. This system generates Web questionnaires allowing operators to complete their questionnaires on-line.

Eventually, all of NASS' questionnaires will be in the QRS and "almost" all questionnaires will have a Web option, including the 2007 Census of Agriculture. Having almost all surveys available for EDR, is imperative in obtaining a positive return on investment for PED data collection. However, some questions would have to be re-written to accommodate the personal interview mode. Currently, questions in the QRS are written for the self administered mode.

This will allow SSOs to send any survey work to the field even at the last minute. Also, when an operation is in multiple samples, the enumerator can obtain data for all of the questionnaires at once.

A.3.1 Obstacles

Below are the major obstacles that would need to be overcome.

- Providing the capability for a statistician to use the Survey Management System (SMS) to mark those operators that need to be field enumerated. Also, the capability to upload this information to the WSFE so that it can later be downloaded to a PED along with the appropriate questionnaires. This would require modification of SMS.

- Developing the (WSFE) to handle the transmission of questionnaires, collected data, work assignments etc. between SSO staff, enumerators and the supervisory enumerators.

- Providing for the security of the data.

Web site security would be needed, but the same security that is being used for EDR could easily be leveraged.

Security of the PED, itself, will need to be researched. In the event the device is lost or stolen, no one should be able to access the information on the device. This would need to be researched to find a product for the selected device.

The data that are being transmitted need to have some form of encryption. Currently, a pilot project using PDAs for data collection by the NC SSO will help us answer this question in more depth. However, additional research is needed to see what other software is available to meet our data encryption requirements.

- Providing the capability to download the questionnaires of interest, sample information, historical data, and edit checks to any PED. A very basic demo was shown by STG on how one could take a questionnaire from QRS and have it loaded and running on a tablet PC.

- Identifying Global Positioning System (GPS) software and hardware that would provide field enumerators with the most efficient route for the day based on their appointments. There are several route planning products on the market but research would have to be done to see which one cost effectively meets NASS' requirements. This hurdle should really be viewed as an option and not as a requirement.

Note: *A NASS pilot study on using GPS devices for ARMS Phase II is currently underway in the Washington SSO. The goal of the project is to see if using GPS devices for recording the latitude and longitude coordinates for the sampled field is more efficient than the current method of using paper county maps and DLG mapping software.*

- Choosing a PED device that handles the vision and is cost effective. Based on my findings I am recommending the convertible or the tablet PC. Both units would compliment the vision.

- Increasing Technical Support Staff to

handle any hardware problems or computer viruses that will arise.

- Budgeting training costs on how to use the PED and the cost and time on obtaining "buy in" of using PEDS to the enumerators.

In the January 30, 2004 - FO Info, it was stated that the supervisory enumerators who came to Washington DC for a meeting with Field Operations noted that they "*were not receptive to the use of laptop computers for data collection by field enumerators. In the field, data is collected in a variety of places (barns, fields, etc.) Members thought laptops would limit enumerators flexibility for getting data.*"

This statement was based on only two supervisory enumerators and their knowledge of the capabilities of laptops or other PEDs is unknown. However, we must recognize that any change is not always embraced by everyone right away. Therefore, education on the use of the selected PED is critical.

- Rewriting of some questions for field enumeration. Currently, questions in the QRS are written for the self administered mode. This would require additional staffing.

- Budgeting for the costs of back-up devices to replace any PED that fails in the field, as well as, shipping costs associated with providing a new one to the field enumerator in a timely manner.

- Staffing - additional staffing would be needed.

A.4 Implementation

Once the infrastructure is in place, tested and fully operational, NASS could move forward with the actual implementation of the selected PED for data collection. Suggest a five year phasing in process. This will allow NASS to gradually introduce the selected PED to the SSOs and allows NASS to avoid taking the substantial monetary plunge required of a full-scale implementation.

- Phase 1 - Year 1

Implementation would begin in the North Carolina and the Virginia SSOs. North Carolina was selected since their enumerators are already collecting data using PDAs and are growing accustomed to using computers in the field. Virginia was selected due to their proximity to Washington DC and the Research and Development Division. Staffing for technical support could be minimal until full scale implementation is completed. Additional 4 FTEs: (1- PED Survey Manager, 1 - PED Assistant, 2 - Information Technology Division Staff).

- Phase 2 - Year 2

Five SSOs that are willing to implement this technology and that have field enumerators with a high workload. Per enumerator Additional 2 FTE - PED Assistants.

- Phase 3 - Years 3-5

Implementation of PEDs in thirteen SSOs during each year. Additional - 2 FTE - PED Assistants.

- Year 6 - Equipment Replacement

Replace those devices used in Phase 1 & 2, if necessary.

- Year 7 - Equipment Replacement

Replace those devices distributed in the first round of Phase 3, if necessary, etc.