Data Capture Technologies and Financial Software for Collecting Consumer Expenditure Data

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Prepared for:
Bureau of Labor Statistics
2 Massachusetts Avenue, NE
Washington, DC 20212

Prepared by:
Westat
1600 Research Boulevard
Rockville, Maryland 20850-3129
(301) 251-1500

Westat®

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Executive Summary

The Consumer Expenditure Survey is a key source of data about consumer purchasing in America. It consists of two data collection efforts, the Quarterly Interview Survey and the Diary Survey. In the Quarterly Interview Survey, field interviewers conduct Computer-Assisted Personal Interviews at a sample of households five times over a 15-month period. Respondents report all expenditures for all members of their households. The Diary Survey has a separate sample of households. Respondents use paper-and-pencil diary forms to record all purchases by all household members. The diaries have a pocket for the respondents to store receipts and other documentation.

The quality of the data collected in the Quarterly Interview Survey and the Diary Survey is currently very dependent upon the accuracy of the respondents' memories. The respondents are not encouraged to use smart phones or other technologies to collect data about their purchases. This reliance on the respondents' ability to recall information may have a negative impact on data quality. Conceivably that problem might be mitigated through the appropriate use of technology.

The purpose of this project was to identify mobile data capture technologies and financial software packages that might be applicable to data collection for the Consumer Expenditure Survey and to determine how those technologies might be applied to reduce measurement error.

Working with Bureau of Labor Statistics, the research team carried out the following project tasks:

- Identifying the technologies that might be useful for data collection in the Consumer Expenditure Survey
- Listing products in each technology category
- Researching the capabilities and characteristics of each product
- Creating matrices showing the products, and their capabilities and characteristics
- Proposing solutions for the Consumer Expenditure Survey employing those products

The technologies that were identified as relevant to the Consumer Expenditure Survey are as follows:

- Financial software packages
- Smart phones and associated technologies including image capture, audio capture, texting and email
- Financial applications for smart phones
- Barcode software for smart phones
- Receipt scanners and optical character reader software
- Mobile carriers

- Mobile operating systems
- Laptops and tablet computers

The research team reviewed products in each of those technology categories. The team created matrices showing the products reviewed, and their capabilities and characteristics. The team considered how the products might be applied to collect data about each kind of expenditure:

- Purchases by check
- Purchases by credit or debit card
- Purchases by PayPal or similar service
- Automatic fund transfers
- Purchases with receipts
- Purchases by cash with no receipts
- Purchases by money order or cashier's check
- WIC voucher or food stamp purchases
- Recurrent expenses or large, unusual expenses
- Purchases by gift and rebate cards
- Purchases of items labeled with barcodes
- Online purchases
- Returns and exchanges

This report presents a proposal for data collection in a redesigned Consumer Expenditure Survey. With the proposed data collection system, the respondents could employ many techniques to supplement their memories when they report data in the Consumer Expenditure Survey. The recall aids could be in many forms:

- Data files downloaded from banks, credit card companies, PayPal, or other financial institutions, showing for each transaction: the date, dollar amount, and in some cases the payee
- Data that the respondents manually entered into their smart phones, using an application developed specially for the Consumer Expenditure Survey
- Text messages about purchases. The respondent could enter a description of the items purchased, the price of each item, and other data
- Email messages about purchases. Again, the respondent could enter a description of the items purchased, the price of each item, and other data. Or, online merchants might send purchase confirmation emails
- Web pages confirming online purchases
- Barcode data that the respondents scanned into their smart phones. These barcode data could be converted into a list of items purchased

- Files containing scans, or possibly photographs, or receipts. OCR software would convert those scans or photographs into text files
- Photographs of the place where a purchase occurred, or of the merchandise purchased
- Audio clips containing information about purchases. The respondent could record a description of the items purchased, the price of each item, and other data

Of course, these recall aids would almost never contain all of the information required by the Consumer Expenditure Survey. For example, credit card data files show the total amounts for purchases, not the individual items purchased. A followup computer-administered questionnaire would be needed, so that the respondents could provide all the needed information.

Respondents could send their data to a central system. That is, they could email photographs, audio files, downloaded account data files, purchase confirmation web pages, and the other recall aids to a repository that had been set up for each individual respondent. After having sent these data to the central system, a respondent could log in to a web site built specially for the Consumer Expenditure Survey. The web site would administer a Computer-Assisted Self Interview (CASI) to collect all the needed data about each purchase.

This proposed data collection system has advantages and drawbacks. One advantage is that it allows respondents to select technologies that they prefer, such as texting or receipt scanning. One disadvantage is that some respondents will find technology to be cumbersome. Also, respondents who were unaccustomed to smart phones or other technology, or who cannot download data from their bank accounts simply because they have no bank accounts, might continue to use paper-based data collection methods. That disparity might introduce a systematic bias into the data.

History and Purpose of the Consumer Expenditure Survey

The Consumer Expenditure Survey is a key source of current and ongoing data about consumer purchasing in America. Additionally, it provides extensive data about consumers themselves, including statistics about income, age, education, race and occupation, and the number of earners in families. Researchers use these data to study, for example, the relationships between consumers' demographic characteristics and purchases. The data also have an important role in revisions of the Consumer Price Index.

The Consumer Expenditure Survey consists of two data collection efforts, the Quarterly Interview Survey and the Diary Survey. Each has its own sample of respondents. In the Diary Survey, the respondents are asked to keep track of all their purchases, and the purchases of each person in their households, each day for two consecutive 1-week periods. The respondents record these purchases using paper-and-pencil diaries. The Diary Survey is primarily a means to collect information on small or frequent purchases, but it covers all expenses during the reporting periods.

In the Quarterly Interview Survey, interviewers visit respondents every three months for a total of five interviews in a 15-month period. The same respondents provide data about the purchases of all household members. The Quarterly Interview Survey is designed to collect data about larger household expenditures, such as purchases of appliances and automobiles, and recurrent expenses, such as utility payments. In the initial interview session, the interviewer collects information on demographic and family characteristics and on the inventory of major durable goods owned. In the fifth interview, the interviewers ask supplemental questions about changes in household assets.

The Consumer Expenditure Survey had been administered at approximately 10-year intervals from the late nineteenth century to 1980. It has been a continuous survey since 1980.

Current data collection methodology

Diary Survey. Respondents in the diary survey first list all the members of their households. Then, the respondents use paper-and-pencil diary forms to record all purchases by all household members. The diaries have a pocket for the respondents to store receipts and other documentation. The diary form is available at http://www.bls.gov/cex/csx801p.pdf.

The instructions printed in the diary include this text:

> Fill out this diary for an entire week, writing down EVERYTHING you and the people on your list spend money on each day – the products you buy, the services

you use, the household expenses you have during the week – no matter how large or small they are.

We recommend that you record your expenses each day. Think about where you went and what you've done.

Talk to the people on your list every day to find out how they spent their money.

Include payments by: cash, check, food stamps, credit/debit card, money order, WIC voucher, automatic withdrawal/payroll deduction, store charge card, grocery certificate.

Keep receipts and other records so that you will remember to record what you bought or paid for. Use the pocket at the back of the diary to store them.

Some record types include: receipts, utility bills, pay stubs, bank statements, telephone bills, catalog/Internet order invoices, credit card statements.

The diary is arranged into four sections, corresponding to four categories of expenditures:

- Food and drinks away from home
- Food and drinks for home consumption
- Clothing, shoes, jewelry, and accessories
- All other products, services, and expenses

The respondents must enter a description and the amount paid for each item purchased. They are also asked to enter several additional details. For example, for purchases in the category "food and drinks away from home," the respondents must enter the price of any alcoholic beverages consumed as part of the meal; whether those beverages were "wine," "beer," or "other"; whether the meal was "breakfast," "lunch," "dinner," or "snack/other"; whether the place of purchase was "fast food take-out delivery concession," "full service places," "vending machines or mobile vendors," or "employer or school cafeteria." Similarly, respondents must enter a number of details about purchases that fall into the other three categories.

Respondents are also required to note any returns or exchanges. They must cross out the original purchase, enter any merchandise received in exchange, and if necessary adjust the price paid.

Currently, the respondents are not asked to consider using technologies such as smart phones, personal computers, or email to help them remember their expenditures. Instead, the respondents must rely on their memories and any receipts or other documentation that they save.

Quarterly Interview Survey. Field interviewers from the Census Bureau conduct face-to-face interviews for the Quarterly Interview Survey. Formerly, they read questions from a

booklet, and wrote the responses in that booklet. Since April, 2003, they collect the data via Computer Assisted Personal Interview (CAPI). They read questions from a laptop screen, and type in the responses. This questionnaire is available at http://www.bls.gov/cex/capi/2010/cecapihome.htm.

The CAPI instrument is programmed in Blaise, a Windows-based survey system developed by Statistics Netherlands and licensed by Westat in the United States. The web site for the Consumer Expenditure Survey points out that the CAPI method has many advantages over the paper booklets:

> … the length of the interview is lessened by the use of a computerized questionnaire. Furthermore, the complex structure of the questionnaire (i.e., changes in question order being dependent on the preceding response) is more easily managed by the CAPI system, thus reducing the burden on field representatives. Interviewers also have the ability to incorporate notes throughout the CAPI questionnaire, where they were previously limited to a few blank lines on the paper instrument. In terms of data processing, the use of CAPI generates great efficiency improvements by eliminating the need for keying information that was previously hand-written. The CAPI system also includes built-in range edits for several expenditure items allowing the field representative to verify reported amounts at the time of collection, rather than having data programs perform these edits post-interview. Finally, with the introduction of the CAPI instrument, several wording changes were implemented throughout the Interview Survey, both to streamline some of the more complex sections of the questionnaire and to modernize some of the language (for example, "Video tape recorder, video disc player, or video cassette recorder (VCR)" is now "VCR, DVD player, or laser disc player."

Potential measurement error

The Bureau of Labor Statistics has made the quality of the Consumer Expenditure Survey data a very high priority. However, the respondents in the Consumer Expenditure Survey are required to report detailed information and may easily omit or misstate some of their expenditures. These data quality problems are not necessarily the result of respondent laziness or disinterest. The methods of the Consumer Expenditure Survey may create opportunities for error.

For example, respondents might encounter problems reporting online purchases. Often, the receipt in an online purchase is only an email message or an electronic document. Respondents might not be in the habit of printing out these receipts. Also, many payments are commonly handled automatically. For example, consumers can make loan payments, or payments for utilities, rent, or credit cards, by setting up their accounts to complete these transactions through the Automated Clearing House (ACH) Network. Because these fund

transfers are entirely automatic, some respondents may not remember to report them in the Consumer Expenditure Survey.

Moreover, some transactions do not involve any receipt or other documentation. Many vendors do not provide a receipt unless they are specifically asked. Respondents who neglect to ask for a receipt and then forget the transaction may omit data from their diaries. Even respondents who assiduously collect documentation for every transaction may encounter problems with receipts that contain an inadequate description of the items purchased. If the respondents cannot remember the details of those transactions, they may report erroneous data.

Respondents may also fail to remember unusual purchases. For example, respondents may fail to remember that an emergency home repair is a purchase that they are required to report on the survey.

In sum, the current methods of the Consumer Expenditure Survey rely heavily upon the respondents' ability to remember expenditures. Memory is fallible. The Bureau of Labor Statistics recently contracted with the National Academy of Sciences to explore methods to enhance data quality in the survey. Those methods might involve technologies such as financial software packages and mobile devices.

Purpose of this project

The statement of work for this project states:

Services are needed to assist the Consumer Expenditure Surveys Program in identifying available mobile data capture technologies and financial software packages, and determining their potential for use in a redesigned survey…The project includes market research to determine what mobile data capture technologies and financial software packages are available, an assessment of their potential usefulness for the collection of the type of data required for the Consumer Expenditure Surveys, and a report summarizing the findings with recommendations for further testing or adoption…The goals of this project are to (a) produce a comprehensive list of mobile data capture technologies and financial software applications, and (b) provide a summary of features, limitations, costs, and potential usefulness for collecting consumer expenditure data from respondents in a redesigned Consumer Expenditure Survey.

If mobile technologies and financial software packages can be used to collect survey data effectively, then the quality of the data may become less dependent upon respondents' recall accuracy. This project was intended to reveal the potential benefits and drawbacks of these technologies, and to identify the most promising innovations to consider.

Method for this project

Method

Working with Bureau of Labor Statistics, the research team carried out the following project tasks:

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Identifying the technologies. The technologies that were identified as relevant to the Consumer Expenditure Survey are as follows:

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Listing products in each technology category. At the outset of the project, the research team was aware of many of the products available in each of those technology categories. The team learned of many additional products through Internet searches.

Researching the capabilities of the products. The research team could take advantage of several resources to learn about each product. For many products, the web site for the product contained detailed descriptions, manuals and extensive Frequently Asked Questions sections. The web sites for some other products, however, provided relatively scant information.

The web sites for some products offered forums or similar features for users to communicate with one another online. Often, representatives from the manufacturer also participated. For example, the financial software package Ace Money offers a Wikipedia-like resource for users to post information about this product. The financial software product Mint offers "Mint Forum" in which users can post observations or ideas about this product, or

comment on other users' posts. These online discussions sometimes provided the information that the research team needed about the products.

Review articles in online technical magazines were sometimes a useful source of information.

In a few cases, the research team could study the products directly. Various smart phones and laptop computers were readily available. Some financial software packages were free to download. However, the budget for this project did not permit the purchase of any products.

Sometimes the research team emailed questions to a vendor via the "contact us" feature on the web site to obtain information about a product.

This research was conducted in late 2010. The research team believes that the findings are accurate as of that time. However, the research team observed that the products in each category were rapidly evolving. For example, two well-known financial software packages were discontinued, and several new financial software packages went on the market, around the time this project began. The capabilities of the smart phones and mobile carriers available to consumers are also changing at an extraordinarily rapid rate. Readers of this report may therefore encounter some outdated information about the available products.

Creating matrices. The research team created a matrix for each product category. Each matrix shows the individual products in each category and the characteristics and capabilities of each of those products. The matrices were intended to provide a summary of the range of products currently available. These matrices are included as appendices in this report.

Proposing solutions. The research team proposed data collection techniques that might improve data quality in the Consumer Expenditure Survey by helping respondents record and recall details about their purchases. These techniques did not use the reviewed products "out of the box," with no modification. For example, the research team did not find that any financial software package could be useful by itself as a data collection tool for the Consumer Expenditure Survey. However, the team did find that specific capabilities of financial software packages might be useful. Those specific capabilities could be incorporated into software to be developed specifically for data collection in the Consumer Expenditure Survey.

Final report

This report describes the capabilities of the individual products in each product category. It also describes how some of those capabilities may be relevant to data collection in a redesigned Consumer Expenditure Survey. For example, one of the reasons financial software packages were created is to help users adhere to a budget; however, that capability is not relevant to the Consumer Expenditure Survey. Financial software packages also have the capability of

automatically acquiring data about credit card purchases; that capability could be very relevant to the Consumer Expenditure Survey. This report focuses on such product capabilities and how they have the potential to enhance data quality in the Consumer Expenditure Survey. The report also covers potential drawbacks to any product, such as a high cost, or excessive respondent workload.

The methods of this project were not intended to lead to definitive conclusions about new solutions to use in the Consumer Expenditure Survey. The project was designed to inform discussions about those solutions.

Reviewed technologies

Financial software packages

Two common types of financial software packages for personal computers and mobile devices are as follows:

- Software to help users track and attempt to limit their expenses in order to adhere to a budget
- Software for managing household or business finances, keeping records, cutting checks, and handling other financial matters

A third type of financial software helps users record specific expenses such as business trip expenses that an employer will reimburse. That software is discussed below in the section on financial software for smart phones.

Appendix A contains the matrix for financial software packages. The matrix indicates that a very large number of these software products are available. Currently, Mint is a very popular budgeting tool, and Quicken is a very popular financial management product. Both are products of Intuit.

Approach. All the financial software packages listed in Appendix A that help users create and adhere to a budget take a similar approach. First, they ask the user to set monthly spending goals for each of a number of expense categories. For example, the user could specify a monthly maximum for expenses in the category "entertainment." Then, the software helps the user to record all expenses, categorize those expenses, and compare actual monthly expenses in each category to the monthly budget targets.

Credit card, debit card, and checking account data. With one exception, all the financial software packages listed in Appendix A allow users to import records of credit and debit card accounts, checking accounts, and PayPal and similar accounts. There are two ways

that users can import records. Some of the financial software packages allow the users to select the name of a financial institution and enter the login name and password that they use to access financial data on that institution's web site. The software then automatically downloads the user's account data. The column titled "automatic data capture" in the matrix in Appendix A shows the products that offer this automatic download feature. These financial software packages typically download these data on a fixed schedule, such as every time the user logs in.

Of course, for these downloads to occur, the financial institution's web site has to permit them. Most financial institution's web sites do permit them; for example, the user literature for Mint claims, "We connect to almost every U.S. banking financial institution with Internet banking capability, from checking to credit cards to retirement accounts and more–saving you hours of tedious data entry." Mint and the other financial software packages that support automatic data file downloads use software architecture known as Representational State Transfer (REST) and a protocol known as OAuth. The web sites of the financial institutions must have compatible web services to interact with these financial software packages.

As an alternative, users can log into the web sites of their financial institutions themselves, without the intervention of the financial software, and download a file containing their account data. The file can be in a number of formats such as QFX (compatible with Quicken), QBO (compatible with the Intuit product QuickBooks), OFX (compatible with the discontinued product Microsoft Money), and CSV (comma separated values, compatible with many products such as Microsoft Excel). Users then import this downloaded file into the financial software package. Users never enter their usernames or passwords into the financial software package. This method avoids any concerns that users may have about the security of their usernames and passwords. However, it requires a bit more effort on the user's part.

The financial software package Buxfer has a unique feature called Firebux that works only with the Firefox browser. Users manually download a file with their financial data from their financial institutions while Firebux records all of the users' keystrokes. After that, users simply click the Firebux icon to replay those keystrokes automatically and download the file again.

Register of expenditures. Financial software packages incorporate the downloaded data into a register of expenditures. These registers resemble checkbook registers. They show the date and the amount of the expense. For credit and debit card expenses and for ACH payments, they also show the payee. For expenses paid by check, they show the number of the check but they do not show the payee, because the identity of the payee does not appear in the downloaded data. The user must manually enter the payee into the register.

All of the financial software packages listed in Appendix A allow the user to customize the appearance of the expense register, to a varying degree.

Categorization. Many financial software packages attempt to categorize expenses automatically when the payee is known. These products are indicated by checkmarks in the column titled "categorization" in the matrix in Appendix A. The accuracy of the categorization process is not perfect. The instructions for the products admit that the user must review the categorization and correct errors. For example, the software may always categorize expenses as "restaurants" when the payee is "McDonald's" or other restaurant chain. It may always categorize expenses as "clothing" when the payee is "Old Navy." However, the software may not be able to correctly categorize purchases from less well-known vendors. Also, the software can make mistakes; in one online discussion, someone complained that his payment to "McDonald Mortgage" was automatically categorized as "restaurants."

The financial software packages Thrive and BankTree Personal are programmed to "learn" how to categorize expenses. Once a user puts an expense from a vendor into a particular category, the user can have the software automatically put all subsequent expenses from that vendor into that category.

Buxfer, a financial software package, allows users to "teach" the software how to categorize certain expenses. For example, users cans set the rule for the system to always categorize expenses whose payee names include the word "pizza" as "restaurants."

Manual entry of expenses. Most of the financial software packages allow users to enter expenses into the register manually. In the matrix in Appendix A, the checkmarks in the column titled "cash expenditures" indicate which products have this feature. Users employ this feature to enter expenses that were paid for in cash, rather than check or credit or debit card, and which therefore do not appear in the downloaded data. This feature is especially important for users who do not have credit cards or checking accounts.

Transaction reconciliation. With some financial software packages, the user enters all expenses into the register as those expenses are incurred. Later, when the user imports data from banks, credit cards, PayPal, and so on, the software reconciles those data with the expenses that the user had already entered manually. For example, the user might enter the amount, vendor, and date of an expense. When that expense subsequently appears in credit card data, the software would match the credit card charge with the manually-entered expense. The user would verify that the two were the same. The "transaction reconciliation" matrix column in Appendix A indicates which products have this feature.

Expense splitting. Most financial software packages allow the user to split an expense into its component expenses, which the user can then categorize. For example, credit card data might include a charge to a retailer like Target or Wal-Mart. That single charge might include multiple purchases of clothing, food, and books. The user would split that expense into the individual items purchased, and put each of those items into the appropriate categories. The "splitting" column in the matrix in Appendix A indicates which products have this feature.

Notations. With some products, the user can create multiple-choice tags as an additional method for categorizing expenses. For example, the tag choices might be "personal" and "business."

None of the products reviewed for this project allows the user to create a set of tags for use with one expense category but not the other expense categories. For example, a user cannot create tags such as "winter clothes" and "summer clothes" and apply those tags only to the "clothing" category. Once a user creates tags, those tags are available for use with expenses in all categories.

Buxfer allows users to attach an image of a receipt to an expense.

Most products allow users to type in text to describe an expense. The expense register contains a field in which the user can enter notes, such as, "This is the sort of purchase that I can eliminate to keep to the budget."

Returns and exchanges. The expense registers in financial software packages can include returns and exchanges. For example, if a user returned a purchase from a particular vendor for a refund, the user might manually enter that information in the register. If the refund is credited to a charge card account, the credit would appear in the data for that account when those data were downloaded later.

Users can categorize returns using the same category scheme that they use to categorize expenses. Exchanges are treated as a return of the merchandise that had been purchased, plus a new expense, for the merchandise obtained in the exchange.

However, none of the financial software packages reviewed for the project allowed the user to associate a return or an exchange with a particular purchase. For example, the expense register might show that merchandise was returned to particular vendor for a refund of a particular amount, but the register would not show which specific purchase listed earlier on the register was the for the merchandise that was returned.

Calendars. Almost all of the financial software packages include a calendar, which appears on the computer screen either like a wall calendar, with each row showing a week from Sunday to Saturday, or a desk calendar, with each row representing one day. Checkmarks in the column titled "calendar" in the matrix in Appendix A indicate which products have this feature. These calendars allow users to post and view upcoming bills. The calendars also show when bills are past due.

An important function of the calendars is to help users manage recurrent expenses such as rent, loans, and utilities. They also help users remember the due dates for unusual expenses such as down payments on a major purchase. In this way, the calendar serves as an electronic reminder system.

Data export. Users can export the expense register in a number of formats, depending on the individual financial software package. Some, such as Mint, export only in CSV format. Others can also export the data in HTML, TXT, QIF, and OFX format. The matrix in Appendix A shows the capabilities of the various products in the column titled "data export."

SDK. Four of the financial software packages reviewed for this project have software developer kits (SDKs) or application programming interfaces (APIs). An SDK is a set of tools that software developers can use to create new applications. For example, a video game console might come with an SDK that developers might use to create new video games that are compatible with that console.

An API is a set of standards that a developer follows to call procedures. For example, Google offers an API that software developers use to call procedures for creating graphs from existing data.

The financial software package Buxfer comes with an API that allows developers to customize the way that Buxfer handles financial information. The API includes standards for creating commands for manually adding a transaction, uploading data from a financial institution, displaying a list of transactions 25 at a time, displaying a list of accounts with balances, displaying a list of loans, displaying a list of bill reminders, and so on. Developers can include these commands in applications that they created in the programming languages Ruby, Python, PHP, or Perl.

Moneydance also has an API. Developers can write Python code that adds new functionality to Moneydance. The API allows developers to embed calls to Moneydance services within that code. The API includes calls that display the user's bill reminders, or categorize transactions, and so on.

Rudder also came with an SDK which is not of any use. Rudder is no longer available.

The financial software package Yodlee MoneyCenter has an SDK that has spawned many software products. Some are themselves financial software packages, including Mint. Some are widgets that add new capabilities to the web sites of financial institutions. The Yodlee SDK has three parts:

- A development platform based on Adobe Flex, an open source framework for creating web pages. Adobe Flex is often used to create ecommerce web sites
- A framework for authenticating requests to access data on the web sites of financial institutions, using the OAuth protocol
- A set of APIs for accessing Yodlee procedures

The APIs enable developers to create applications that have a great deal of functionality, such as the following:

- Download and display data from bank, investment, and other financial accounts
- Add or edit accounts manually, without downloading them
- Add or edit transactions manually
- Display bill reminders
- Create a budget
- Search for transactions
- Categorize transactions

Platforms. All of the reviewed financial software packages for keeping a budget run on personal computers. All also have applications that run on smart phones. In other words, users can or enter, manage, or view their financial data on either platform.

Products such as Quicken for managing household or business finances run on personal computers but also have applications for mobile devices.

Some applications run on mobile devices without a counterpart that is primarily for personal computers. Those products are covered below in a separate section of this report on financial products for smart phones.

Multiple users. With all of the reviewed products, users must enter a password to gain access to their data. The products allow multiple users to share a password. In this way, if many people in a household were all attempting to adhere to a common budget, they could enter and view their expenses on a single expense register.

Buxfer has a unique feature to support roommates who make common purchases but maintain separate budgets. A purchase of a $20 item, for example, can be allocated as $10 paid by one roommate, $6 paid by a second roommate, and $4 paid by a third roommate. A single purchase can be divided among expense registers.

Unusual features. A large number of financial software packages are currently available. Twenty were reviewed for this project, but many more exist. These products are constantly adding new features as they compete for new users. Some, like Rudder and Wasabe, once had many users but were discontinued.

Some products have taken steps to distinguish themselves from the competition. For example, Bundle, developed collaboratively by Microsoft, Morningstar and Citigroup, has a social media component. When users create a budget for themselves, they can review data about how others who live near them spend their money.

Buxfer takes advantage of the fact that many of its users like to text and use email. It allows users to manually add purchases into the expense register by texting or emailing the relevant information. The system automatically updates the user's expense register.

The Expense Tracker has a unique feature employing speech recognition. Users can telephone a speech recognition system, and then say the amount and category of an expense. The system then automatically enters the data into the user's expense register. Users also have the option of texting this information or entering it online.

Relevance to the Consumer Expenditure Survey. The primary purpose of the reviewed products is to help users avoid overspending, or to provide a means for users to keep financial records for a business or household. Their primary purpose is not to collect data. However, the various products contain a number of features that could be very useful for data collection in the Consumer Expenditure Survey. Looking across all of the products reviewed, many features could be useful.

These software packages always have a transaction register that displays all purchases and their amounts. These registers are exactly what the Consumer Expenditure Survey requires, so long as they include the particular data needed in the survey.

Financial software packages allow users to download data from their financial institutions. This feature can capture data from checking, savings, and credit card accounts, PayPal accounts, investment accounts, and so on. These data could cover all purchases except those made by cash, money order, cashier's check, WIC vouchers, food stamps, and gift or rebate cards. The web sites of virtually all financial institutions support automatic downloads. Users who do not wish to enter their passwords into the software package, and users whose financial institutions do not permit automatic downloads, can download the data manually.

Most financial software packages also allow users to enter transactions manually into the transaction register. This feature allows users to log cash expenses and other expenses that might not be in the data downloaded from financial institutions.

Financial software packages allow users to split expenses. The Consumer Expenditure Survey focuses on individual purchases, not overall charges. For example, credit card data may show that a user made a $25 purchase at Wal-Mart, without showing that the purchase included a $5 food item, $4 book, and $16 piece of clothing. It is these individual purchases that the Consumer Expenditure Survey must capture. The user would need to split the expense in the transaction register to record those data for the Consumer Expenditure Survey.

Financial software packages allow users to categorize expenses. All the financial software packages allow users to place expenditures into a category such as "clothing" or "entertainment." With varying degrees of flexibility, the software packages allow users to create new categories, delete unneeded categories, and split categories into sub-categories. The Consumer Expenditure Survey currently asks users to categorize expenses; there are only four categories.

The various financial software packages take different approaches to categorize expenses. Some have an engine that automatically categorizes expenses. However, the instructions for these products admit that the accuracy is not perfect. Some allow users to set rules for categorization. Perhaps the most straightforward approach for the Consumer Expenditure Survey is to ask respondents to manually categorize each expense, rather than use any of these automatic features which potentially could introduce errors if users did not check all categorizations adequately.

Many financial software packages have calendars. Users enter recurring expenses such as rent in these calendars. However, the users need to remember the expenses in order to enter them in the calendar. Calendars do not by themselves help users to remember the expenses. For that reason calendars may have limited applicability to the Consumer Expenditure Survey.

With all the financial software packages, multiple users can enter data onto a single expense register. For example, all the members of a single household might share a single password, and enter all their expenses onto the register. This feature may be useful for the Consumer Expenditure Survey, which captures data for all the individuals in a household.

Four of the reviewed financial software packages offer a means for software developers to create new applications. These SDKs or APIs could permit a developer to create an application specifically for data collection in the Consumer Expenditure Survey. The application would not include features, such as budgeting tools, that are crucial to the financial software package but unnecessary and distracting for the Consumer Expenditure Survey. The application would include just those features, such as financial data downloads, that are needed for the Consumer Expenditure Survey.

In particular, developers have used the Yodlee SDK to create many new applications. According to the Yodlee web site, the SDK is used for hundreds of applications, which appear on the web sites of many major financial institutions. This SDK might be very useful to developers creating a data capture application for the Consumer Expenditure Survey. Further research is needed to determine the extent to which the Yodlee SDK is suitable for that role.

Mobile carriers

Several mobile carriers offer reliable service in the United States. The smart phones reviewed in this project operate on AT&T, Verizon, SprintNextel, or T-Mobile. Appendix B contains the matrix for these mobile carriers.

Capabilities and speed. Each carrier uses one of several available mobile technologies for their network infrastructure. Mobile devices sold by a particular carrier operate on that

carrier's network and may not be able to operate on other carrier networks. It can never be assumed that a particular device can be used across all networks.

For example, AT&T and T-Mobile use the Global System for Mobile (GSM) technology standard. Mobile devices purchased through AT&T do not operate on the Verizon and Sprint networks which use a different standard, called Code Division Multiple Access (CDMA) technology.

For data services such as email and web browsing, carriers have deployed a third generation (3G) network infrastructure that is fast enough for most uses. However, users might judge uploading and downloading very large files to be slow. Most carriers have a 4G next generation data network plan to provide even higher speeds in the near future.

Another important consideration is the coverage areas of the various carriers. Appendix B provides links to official coverage maps for each carrier. Coverage areas are also displayed in web sites such as http://www.cellreception.com/towers/towers.php, which shows actual cell tower locations.

Price. Mobile carriers set the price for their service in a very competitive environment and often bundle their service pricing with devices. Mobile providers typically sell smart phones at a low price but the subscriber must commit to a multiyear contract for both voice and data services with a penalty payment for early termination. The contract may call for additional roaming charges when the device is used outside the coverage area Sample service plans are include in Appendix B.

Relevance to the Consumer Expenditure Survey. If respondents in the Consumer Expenditure Survey were to use smart phones to send data, they would need to have a WiFi connection available or to reside in areas covered by carrier networks. Coverage is currently extremely wide, but not universal. The Consumer Expenditure Survey samples may include some respondents in remote areas with limited coverage, and who are not often in WiFi "hot spots."

An obvious but important consideration is that network carrier subscriptions cost money. Their use in a redesigned Consumer Expenditure Survey will require adequate funding.

Mobile operating systems

Each smart phone uses an operating system that is responsible for managing resources and applications. These operating systems are not interchangeable. They help determine the

look and feel and the capabilities of the mobile devices that run them. An application developed for one operating system will not run on a different operating system. Operating systems for mobile devices are evolving quite rapidly.

Appendix C contains the matrix for smart phone operating systems. They are discussed here individually.

Mobile operating system market share at the time of this writing can be found at this link:

http://www.readwriteweb.com/mobile/assets_c/2011/02/global-os-marketshare-feb.2011-o-27904.php

This section of this report presents mobile operating systems in the order of current market share.

Apple iOS. Apple iOS is a proprietary operating system used exclusively on Apple devices including the iPhone, iPad, and iPod Touch devices. Apple owns this operating system and manages its development and release. There is a large community of developers building applications for the Apple iOS operating system. Apple exercises control over the software applications that can run on Apple devices by allowing or failing to allow any application to be available through Apple's App Store. Developers must obtain authorization from Apple to distribute their applications through the App Store. This requirement is unique to Apple iOS. Users run the risk of voiding their device warranty if they run applications that are not authorized by Apple. However, Apple continues to take steps in order to encourage developers to create new applications for Apple mobile devices. Examples include Apple's providing an SDK to developers, along with tutorials and active support for a quickly growing development community. Additionally, Apple actively promotes developers' products in the App Store, an effective distribution outlet that helps developers market and profit from their work.

Blackberry OS. Blackberry OS is a proprietary operating system developed and owned by Research in Motion (RIM). RIM offers an SDK for software developers but development communities for this operating system are not as large as the ones for iOS and Android.

Android. Android is an operating system owned by Google. It is considered to be "open" because it is a collaborative product of Google and members of the Open Handset Alliance, who have made the operating system source code freely available. The operating system is feature rich and is available for use by smart phone manufacturers at no cost. As a result, Android is the operating system for smart phones from many manufacturers, including Samsung, LG, HTC, and Motorola. Google has an App Store where applications for Android devices can be purchased and downloaded. However, other outlets also exist for users to purchase and download Android compatible applications. Neither Google nor any other group exercises control over the available applications. There is a large community of developers building applications for this operating system.

webOS. webOS is a proprietary operating system used for the Palm Pre. Prior to webOS, Palm OS was the operating system for Palm mobile devices. In 2010, HP acquired Palm and announced a new version of the operating system named webOS 2.0. Currently, new devices are not available in the United States using webOS 2.0. Palm Pre is losing market share and is not as popular as Palm devices had been in earlier years. HP intends to release new devices, including tablets that use webOS 2.0.

Microsoft Windows Mobile. Windows Mobile is an operating system that Microsoft developed for mobile devices. It was initially introduced for use on Pocket PC devices and was once known as Windows CE (Compact Edition). Over the last few years, Microsoft has lost significant share of the smart phone operating system market and has phased out Windows Mobile. Microsoft recently announced a new operating system for mobile devices known as Windows Phone 7.

Target markets. Apple initially targeted the consumer market with its iPhone, but more recently the device has acquired enhanced email capabilities that were once unique to the RIM Blackberry. As a result, the iPhone has also entered the enterprise market. Apple's iPad, a tablet, is beginning to penetrate the enterprise environment as well, as a light weight computer device.

Devices that use the Android operating system have typically targeted the consumer market. However, because of Android's open development environment, enterprise applications are beginning to appear. A number of device manufacturers already have developed or plan to develop tablet devices that use this operating system. These manufacturers will likely target both the consumer and enterprise markets.

Palm has historically focused on the enterprise market. While the HP strategy is still unclear, recently they released information regarding two tablet devices that will run the webOS operating system. The devices appear to target both the consumer and enterprise markets. HP's plans and strategy should become clearer later in 2011.

RIM has targeted the Blackberry toward the enterprise market and until recently dominated that market because of Blackberry's email capabilities. Now, devices for the consumer market from other manufacturers have become so rich in features, including email, that they have become widely accepted in the enterprise market as well. RIM's market position is eroding as a result. Recently RIM has attempted to improve the Blackberry's web browsing capabilities.

Windows Mobile was initially Windows CE for devices such as Pocket PC (HP iPaq). Failing to win sufficient market share, Microsoft retired Windows Mobile and released Windows Phone. With Windows Phone, Microsoft appears to be adopting the strategy of Apple and Android to target the consumer market by encouraging developer communities to create a large number of applications, and then targeting the enterprise market. With Apple and Android

having made significant inroads in these markets it may take some time to see how Microsoft ultimately pursues this strategy.

Multitasking. Multitasking refers to the ability of a smart phone to run more than one application simultaneously, so that a user can switch from one to the other quickly and easily. For example, a smart phone needs a multitasking capability to run a web browser and barcode scanner software simultaneously. With multitasking, the user can stop using the Internet and start scanning a barcode instantaneously. Currently, all operating systems for smart phones support multitasking.

Applications available. A large number of applications are readily available for the iOS and the Android operating systems. Robust developer communities create applications for these two platforms. The number and the variety of available applications for the other operating systems are not as impressive.

Relevance to the Consumer Expenditure Survey. If non-web browser based smart phone applications were developed for the Consumer Expenditure Survey, separate versions would need to be developed if the application were to run on different operating systems.

Smart phones

The research team reviewed the following smart phones for this project: the Apple iPhone 4, the Motorola Droid X, the HTC EVO 4G, and the RIM Blackberry Torch 9800. These smart phones represent a cross section of mobile device manufacturers, and include devices that run the range of popular device operating systems.

The matrix for these smart phone devices is in Appendix D.

Keyboard. Many smart phone devices have some form of keyboard. Some use touch screen "virtual" keyboards while others have small, physical keyboards. There are advantages and disadvantages to both. Some users simply dislike touch screen keyboards. They prefer the sense of pushing a physical key, and find that a physical keyboard enables them to type accurately and avoid "fat finger" errors. Additionally, most touch screen keyboards employ capacitive technology, so users cannot use the keyboard if they are wearing gloves or using a stylus made of a non-conducting material.

All the devices evaluated in this project have a touch screen keyboard. The RIM Blackberry Torch 9800 also has a slide out physical keyboard. Smart phones usually have auto type or auto complete features that can reduce the number of keystrokes for many words. Some products, like the Android devices, have Swype or similar technology that allows users to enter a word by sliding their fingers from one letter to the next on the touch screen keyboard.

Foldout or rollout full QWERTY keyboards are available as an option for some smart phones. Examples include Menotek's rollout keyboard and iGo stowaway keyboard. These keyboards use Bluetooth wireless connections to connect to the mobile device. While Bluetooth drivers appear to be available for the iPhone and RIM device, Bluetooth drivers to connect keyboards to the smart phone are not as readily available currently for Android devices.

Image Capture. Devices such as the iPhone allow users to take photographs relatively quickly and easily. The user selects the camera icon from among the screen icons. The camera application then quickly becomes active so that the user can simply click a button to take a photograph. This process can take as little as 5 seconds. The user can immediately email the photo or send it via Multimedia Messaging Service (MMS).

Audio Capture. All the smart phones reviewed in this project can record and playback audio. The audio clips are stored in files with standardized formats. All the smart phones allow users to save and to transmit these audio files by email or MMS.

The iPhone provides an application called Voice Memos. Users press a "record" button to begin recording an audio file, and a "stop" button to end the recording. The application displays a list of all the recorded audio files stored on the smart phone, with the date and time that the files were made, and the length of the recordings.

Texting and Email. Texting capabilities are ubiquitous across mobile devices, including not only smart phones but also ordinary cell phones, which lack keyboards. Texting is especially popular among young smart phone users.

Email is available on all smart phones. Virtually all smart phone subscribers use their devices for email.

Some mobile network carriers, including AT&T, Verizon, and SprintNextel, may charge separately for texting and email. Often the way that carriers charge for these services depends upon the subscriber's rate plan. With some rate plans, the charges are based upon amount of data or the number of texts messages that the subscriber has sent and received.

Physical Characteristics. Smart phones are now small and light enough to easily fit into a pocket, a purse or be worn on a belt clip. Most smart phones are larger and heavier than most ordinary cell phones. The smart phones considered in this project have a form factor of approximately 4.5 inches in height, 2.5 inches in width and .5 inches in thickness, and a weight of 5 to 6 ounces. For those who are already accustomed to carrying smart phones, these sizes and weight characteristics may be reasonable. For others, smart phones may be uncomfortable to carry.

Built in GPS. All the smart phone devices included in this review include embedded GPS devices. GPS allows users to map their location, and can work in conjunction with products

like Google Maps. Importantly, GPS usually provides more accurate location data outdoors, as compared with indoors.

Carrier Availability. In the United States, smart phones are typically purchased through mobile network operators. Subscribers typically purchase the smart phone when they establish new service, when a contract is renewed, or when the user decides to upgrade. Mobile carriers often attempt to lure customers to their network by being the only one to offer specific, full featured devices. These exclusive arrangements apply to many of the devices that were reviewed in this project, including the Apple iPhone 4 only available through AT&T, the Motorola DroidX only available through Verizon, the HTC Evo 4G available only through Sprint, and the RIM Blackberry Torch 9800 only available through AT&T. This marketplace is changing rapidly. For instance, it was recently announced that iPhones would soon be available through Verizon in addition to AT&T.

Battery life. The smart phones reviewed in this project have many hours of availability when they are used intermittently. The devices conserve power by going into standby mode after a period of non-use. Even when being used continuously, specifications for the devices indicate that battery life ranges from 5.5 hours to 14 hours depending upon the device and the type of use. In this way, even smart phones that are used intensively need to be recharged only about once per day.

Cost. Smart phones cost approximately $200, with the exception of the RIM Blackberry Torch 9800 which costs $99. These prices, however, are dependent upon the subscriber signing a 2-year service contract. The price charged reflects the business model of the mobile carriers: They offer the smart phone at an attractive price and recoup the cost through the 2-year contract.

Westat's experience. Westat used mobile handheld device technologies in the National Occupant Protection Use Survey (NOPUS). Field data collection staff for NOPUS used mobile handheld devices—known as Personal Digital Assistants (PDAs) at the time—to collect information about the drivers and passengers of vehicles waiting at stop lights. The data collectors recorded the use and non-use of seat belts and child safety seats. The data collection staff could move rapidly alongside the vehicles because the PDAs were small and lightweight. The PDAs were not telephones. However, they did collect GPS information to track the location of each data collection point.

Relevance to the Consumer Expenditure Survey. Smart phones have a range of characteristics that may benefit the Consumer Expenditure Survey. First, they are relatively widely used, so a large proportion of the respondents and members of their households may already be comfortable using them. Second, thousands of applications are available for the various smart phone models. Many SDKs and other resources are available to developers who wish to create new applications.

A smart phone could administer a questionnaire to respondents in the Consumer Expenditure Survey. Whenever respondents made a purchase, they could start up an application that administered a set of questions about the purchase. Those questions could include branching logic, so that the respondents answered only the appropriate questions. For example, questions about whether an expenditure should be categorized as "breakfast," "lunch," "dinner," or "other" would appear only when the respondent indicated that the purchase was for food away from home.

The image capture capabilities of smart phones could be very relevant to the Consumer Expenditure Survey. A later section of this report reviews software that allows users to photograph receipts. OCR software then attempts to extract data about the purchase documented on the receipts.

In addition, respondents might take a photograph at the moment of a purchase. That photograph might simply be of the place of the purchase, or of the items purchased. That photograph by itself would contain very little useful information for the survey. However, it could serve to jog the memory of the respondent, ensuring that the respondent did not completely forget about the purchase. The respondent could then provide the information about the purchase required by the survey.

Respondents could also use the audio recording feature of smart phones. They could record a voice file containing information about a purchase right at the moment it occurs, before the respondents have had a chance to forget any details.

The GPS capability of smart phones could also be useful. It could show respondents their approximate whereabouts when they took the photograph, or completed the questionnaire, or made the audio recording. That information could help ensure that respondents remembered the purchase accurately.

The texting and email capabilities of smart phones could also play a role in the Consumer Expenditure Survey. First, respondents could text or email information about their purchases as a way of recording them. Some financial software packages, reviewed earlier, use this capability. Those packages, such as Buxfer, require the user to adhere to a strict format to document the purchase, its category, and its price. If an inattentive user deviates from that format, the software cannot understand the content of the text or email. For this reason, any such system for the Consumer Expenditure Survey would have to accept text or email in any format.

Also, smart phones could be programmed to automatically email the data that respondents enter. For example, soon after a respondent photographed a purchase or a receipt, or recorded an audio file, or responded to a questionnaire that the smart phone administered, those data could be emailed to a central data collection system. The data could be stamped with date and time, and GPS coordinates.

After the photographs, audio files, and other data were collected, respondents could be asked to report all the information about the purchase required by the Consumer Expenditure Survey. Such a system is described later in this report.

Of course, if smart phones were introduced into the methods of the Consumer Expenditure Survey, some problems might follow. First, many people are unaccustomed to using smart phones. People used to ordinary cell phones may find smart phones to be cumbersome. People who are uncomfortable with technology in general may dislike smart phones, be unable to learn how to use them, or simply refuse to use them.

In addition, the introduction of smart phones potentially may bias the results of the Consumer Expenditure Survey. If respondents were allowed to choose between the paper diaries and smart phones, respondents with certain demographic characteristics would disproportionately select the paper diaries. If "mode effects" existed—that is, if the smart phones lived up to their potential of providing better quality data—then people with the demographic characteristics associated with choosing paper diaries would tend to have lower quality data.

On the other hand, mobile devices have been used to collect data in clinical trials of experimental new drugs with a much success. With electronic patient reported outcomes (e-PRO) systems, patients in clinical trials use mobile devices to record side effects and other observations about their health. An e-PRO system can offer reminders to help ensure that patients remember their dosages. It can even administer questionnaires. Perhaps the experiences of clinical trials investigators who have used ePRO systems could help Consumer Expenditure Survey methodologists gain an understanding of how smart phone technologies might affect data collection.

Financial applications for smart phones

Several financial software packages for smart phones were reviewed for this project: Shoeboxed mobile, Budgetdroid, MyBudget, iXpensit, EXGIS, Certify, ProOnGo. The matrix for these products is included in Appendix E.

Some financial software packages for smart phones are intended to help users keep track of their expenses for business purposes. These products allow users to record their expenses, view company policies regarding expenses, and forward their expense reports to company officials for approval. These software packages are intended for business travelers and others who must make purchases out-of-pocket so that an employer can reimburse them later.

Other financial software packages for smart phones are designed to help users limit their expenses in order to adhere to a budget. These software packages are very similar in function to

their counterparts that run on personal computers as well as smart phones, reviewed earlier in this report.

Devices supported. No mobile financial software package can operate on all mobile devices because no package has versions for all mobile operating systems. Of the applications reviewed for this project, only two, Certify and ProOnGo, operate on more than one operating system. Those two products can operate on Blackberry, Windows Mobile, iPhone, and Android devices.

Options for entry of expense information. All the mobile financial applications allow the user to manually record an expense by typing in the related information onto a form visible on the device screen. With the Budgetdroid, Mybudget, IXpenseit and EXGIS, the only way a user can enter an expense is by typing in the information.

Some applications also allow the user to photograph or scan a receipt for an expense. The image of the receipt is incorporated into the final expense report that the user forwards to a company official for approval. With some expense applications, such as Shoeboxed, Certify, and ProOnGo, once the receipt image is captured, it is transferred to a centralized service. OCR technology then converts the receipt image into text, which is used to populate expense report entries.

Data captured. None of the mobile financial software products that use OCR are capable of automatically recording every line of a receipt. All of the reviewed products are programmed to identify the receipt total amount, while ignoring the lines of the receipt that itemize the purchase.

Nearly all of the mobile financial software applications reviewed allow users to type in information about each expense in a field labeled "Notes," "Description," or "Reason." ProOnGo appears to be the one exception that lacks this feature. ProOnGo has a receipt reader for automatically capturing expenses, but does not allow the user to type in any additional information about the expenses. ProOnGo users can, however, use a finger or stylus to add hand-written notes on the smart phone screen.

Expense categorization. All of the mobile financial software packages reviewed allow users to categorize expenses using a standard set of categories. Some, but not all, allow users to define additional categories. IXpenseit allows users to define both categories and subcategories.

Shoeboxed Mobile allows the user to associate a vendor with a category. The application attempts to identify the vendor from the image of a receipt and to automatically categorize the associated expense.

Data export and integration with other tools. All of the mobile financial software packages reviewed allow the user to export the expense information in formats such as CSV.

Some of the products use this export feature to provide integration capabilities with other products. For example, Shoeboxed integrates with Batchbook, FreshBooks and Outright, while ProOnGo integrates with QuickBooks.

Relevance to the Consumer Expenditure Survey. One aspect of financial applications for smart phones is potentially relevant to the Consumer Expenditure Survey: the ability to capture data from photographs of receipts. However, this capability must be viewed with some caution. All of the reviewed products that have this capability capture only the receipt total. They capture no data about the individual items that constitute the overall purchase. However, software developers may well be able to create an application that captures information from a receipt line by line, after OCR software has converted an image of the receipt into text. This possibility is covered later in the report.

It may not be desirable to ask respondents in the Consumer Expenditure Survey to photograph their receipts. The instructions for the financial packages for smart phones emphasize that these photographs must be taken with care. They can be too blurry for OCR software if the user does not hold the smart phone still. The receipt must be correctly framed in the photograph so that the text on the receipt is as large as possible. It is unclear whether a long receipt can be reliably framed by a novice user. In sum, photographing receipts may or may not be feasible for the Consumer Expenditure Survey. Testing with actual respondents is needed.

The results of such testing might suggest that scanning is better than photographing for obtaining a high quality image for OCR scanning. However, scanning a receipt requires more time than photographing a receipt.

Barcode reader software for smart phones

Software is available for many smart phones that allows the camera to serve as a barcode reader. The software then performs a lookup of the Universal Product Code (UPC) in a centralized database and returns product information, which may include price information for the product at various nearby locations. Of course, this software was not designed for data collection in surveys. It was designed for a very different purpose—to assist users for product price comparison shopping.

Importantly, the barcode software can capture only the identity of the product bearing the barcode. It cannot capture the price, although the software may be able to look up the price available at various merchants, if those data were available in online price databases. In addition, barcode reader software products have very limited capabilities with barcodes that are used only within a specific store. Store-specific barcodes, which usually start with the code for a "2," are used for individually weighed and labeled items such as purchases from the delicatessen or fish counter, and are meaningful only within the stores where the purchases occur.

Appendix F contains the matrix for the barcode software products reviewed in this project, including RedLaser, ShopSavvy, The Find, and Google Shopper.

Other barcode readers are available that use laser barcode scanning rather than photography with smart phones. Laser barcode scanning products are used in many ways. For example, visually impaired persons use them to identify the contents of cans and bags in their homes. Warehousemen use them for tracking boxes. Shippers like FedEx use them to track the location of deliveries. They are used by shoppers in major grocery chains to record their purchases before going to the cashier. These standalone barcode readers were not reviewed for this project.

Availability. The barcode reader applications reviewed in this project run on currently popular smart phone operating systems. RedLaser is available for the iPhone; a future version will run on the Android operating system. ShopSavvy and The Find are available for both the iPhone and Android operating systems while Google Shopper is available only for the Android operating system.

Operation. The RedLaser application is available for download from the Apple App Store at no cost. The research team tested that application on an iPhone.

The user clicks a button on the smart phone screen and aims the camera at the barcode on a product's label. RedLaser displays a screen with a frame at the center showing the image being captured by the camera. When the barcode is aligned in this frame, the device automatically captures the UPC code and performs an online lookup for the product information and product pricing.

RedLaser then displays the pricing information. The user can view a screen listing all previously-scanned products, or the user can view the most recently scanned product. The user can email the information for any of the scanned products.

RedLaser performed reliably and easily. The user needed 5 to 10 seconds to complete the process of scanning a barcode. At that speed, however, scanning just half a dozen items might require a full minute.

Scan History. Three of the products considered in this project, RedLaser, Shop Savvy and Google Shopper retain a history of products scanned. The Find appears not to keep such a list.

Capture of Additional information. Of the barcode reader products considered for this project, only Shop Savvy appears to allow the user to type in notes about an item whose barcode has been scanned. The user types in additional data in multiple fields. For example, Shop Savvy could permit a user to type in the price actually paid for an item, or the person who will use the item.

Email capabilities. All the barcode reader applications included in this study can export data about the items whose barcodes were scanned. Shop Savvy allows the user to export those data using Dropbox. Google Shopper uses Gmail. The Find integrates with social media products like Facebook. With RedLaser the data can be emailed.

SDK Availability. Some of the reviewed barcode scanning products have an SDK that allows programmers to develop new applications that make use of the barcode scanning capability. Both RedLaser and ShopSavvy have an SDK. Right "out of the box," RedLaser and ShopSavvy are useful for comparison shopping. The SDK of these products provide programmers with the ability to develop a new product that uses barcode scanning in a way that is useful for other purposes, such as for data collection.

Cost. All the barcode scanning software products reviewed are available from their distributors as free downloads. However, using the products could engender a charge depending upon the subscriber rate plan.

Relevance to the Consumer Expenditure Survey. Developers could use these products' SDKs to create an application for the Consumer Expenditure Survey. Respondents would click an icon on the smart phone screen, aim the camera, and photograph the barcode of the products that they purchased. The software could then look up the barcode in a database. This procedure, however, would only identify the product. It would capture no information about the actual sale price, or any other aspect of the purchase. In most cases, there is no way to query an online database to reliably capture the actual price.

Moreover, many purchased items have no barcodes. Some, such as purchases from a supermarket's meat counter, have store-specific barcodes that cannot be looked up in any publicly available database.

Sometimes, when bar codes are printed on a wrinkled label or a curved surface, scanners cannot read them; they pose problems even for cashiers with years of experience. For these reasons, respondents may sometimes find barcode readers frustrating to use as a means for recording purchases.

Receipt scanners

For the purposes of this project, a receipt scanner is defined as any system that converts the content of a paper receipt into electronic form. Receipt scanners can employ either of two devices: a camera or an optical document scanner. Receipt scanners using smart phone photography were reviewed above in the section on financial software packages for smart phones.

Several receipt scanners that use optical document scanners and OCR software were reviewed for this project. Detailed information can be found in the matrix in Appendix G.

Optical document scanners come in several forms. Some are wands that the user slides over a receipt. Others are small, portable devices with a roller. The user feeds the receipt into the device, so that the roller can move the receipt over a set of optical sensors. Software then creates an electronic image of the paper receipt. Of course, a user could employ an ordinary desktop document scanner to capture an image of a receipt. Desktop document scanners, however, are not easily portable and their software is usually designed for personal computers, not smart phones.

Once the receipt is scanned, the user has several options. The user could transmit the image by email or MMS. All of the reviewed receipt scanners come with OCR software, which could convert the image of the receipt into a text file, word processing file or a document in PDF format.

The portable scanners that were reviewed for this project are as follows: Xerox XTravel Scanner, Brother (formerly Pentax), DSmobile 600, NeatReceipts Mobile Scanner, Fujitsu ScanSnap 300.

Capabilities and accuracy. All the reviewed receipt scanners support 600 dots per inch (DPI) resolution, a level that is easily sufficient for OCR software. There are other factors that affect the accuracy of OCR software, however, such the quality of the printing, the font type, and the font size on the original receipt.

The Xerox XTravel and the Brother DSMobile are TWAIN compliant, meaning that they conform to a standard used to interface imaging hardware with imaging processing software. The NeatReceipts scanner and the Fujitsu ScanSnap appear not to be TWAIN compliant. It may be difficult to develop new software for integration with devices that are not TWAIN compliant.

All the scanners reviewed include software to export the electronic images as files in PDF format. The software for the NeatReceipt scanner supports many additional formats including Microsoft Excel and Word. See the Appendix G for more information about the supported formats.

The NeatReceipts software is explicitly intended to convert the content on receipts into an expense report. The other scanners may work with electronic expense report systems, but they are not sold specifically as a component of any electronic expense report system.

The NeatReceipts software can capture only the total amount of the receipt. It cannot capture the individual items on the receipt. For example, the NeatReceipts software can capture the total amount of a supermarket purchase shown on a receipt, but it cannot capture the cost of the individual items that comprised that total purchase. In this way, the software operates like

the software for smart phones that convert photographs of receipts into electronic format. That software was discussed above, in the section on financial software systems for smart phones.

NeatReceipts is intended for users who have to keep a record of business expenses. It allows users to create expense categories, and to categorize each expense. It attempts to capture the identity of the vendor from the scanned receipts from the text or logo at the top of the receipt.

Price. All the reviewed receipt scanners sold in the $110 to $300 price range. The research team noticed significant price differences among online retailers.

Scanning versus photographing. ShoeBoxed, Certify and IXpenseit allow the user to photograph or to scan a receipt. The user is not required to use just one method to capture the image of the receipt.

Relevance to the Consumer Expenditure Survey. Receipts obviously contain a good deal of information relevant to the Consumer Expenditure Survey, including the date of a purchase, the individual items that constitute the purchase, and the price of each. Receipts for returns and exchanges also contain very relevant information for the survey.

The crucial issue is how to convert that information from text on a receipt into data in a database. Two methods are possible: smart phone photography and scanning. Two forms of scanning are possible, using desktop or mobile scanners. Only testing with actual respondents can reveal the optimum approach. Testing can reveal whether novice respondents can take an adequate photograph, even with very lengthy receipts. Taking a photograph of a receipt presumably always is much faster than scanning a receipt. Testing can reveal whether respondents quickly become dissatisfied using a scanner.

Moreover, many people have little experience with either smart phone photography or with scanners. Only testing can reveal whether respondents can quickly learn the skills they need to use these methods.

Laptop computers

As described earlier, field interviewers in the Quarterly Interview Survey collect data by reading questions from a laptop screen and typing in the responses, a method known as CAPI.

There are several characteristics that make a laptop computer suitable for a CAPI study. The size and weight have to be within a range for the interviewers to carry them without difficulty from one household to the next. The battery has to be sufficient for the laptop to be functional for the full work day, even when the interviewers cannot find a location to recharge the device during the day. The CPU and memory must be suitable for the CAPI application.

The devices reviewed for this study were the following: Toshiba Tecra A11 (S3540), HP ProBook 4520s, Fujitsu Lifebook E780, and Dell Latitude E5510. The matrix for these devices is in Appendix H. Detailed information including product options such as storage is included in that matrix.

Screen image quality. Each of the reviewed laptop computers have a 15.6 inch diagonal screen and provide anti-glare options, which are useful when the laptop is used outdoors or near a window. Several of the devices, including the Fujitsu Lifebook E780, offer display options like high-performance graphics cards and higher resolutions that are suitable for more sophisticated video and image rendering needs.

Physical Dimensions. All the reviewed laptop computers were generally in the range of 14.16 to 14.7 inches in width, 9.8 to 10 inches in height and 1.09 to 1.48 inches in thickness. The HP ProBook 4520s were the thinnest at 1.09 inches. These dimensions appear to be reasonable for a CAPI application while providing screens of ample size.

Weight. The weight of a laptop varies based upon its configuration. A spare battery, for example, adds significant weight. The research team examined weight information provided on the manufacturers' web sites for standard configurations. The reviewed laptop computers weighed between 5.26 to 6.1 pounds. The HP ProBook 4520s appears to be the lightest at 5.26 pounds.

Battery life. Battery life varied significantly among the reviewed laptop computers. The Fujitsu Lifebook E780 manufacturer's specifications suggest that it has the longest battery life, at 12 hours. A test reported for the Toshiba Tecra A11 (S3540) suggested that it has the shortest battery life, at 3 hours and 7 minutes. Many factors can affect the battery life, including the type of use, and the age of the battery.

Manufacturer's specifications for battery life are based on ideal conditions, not the conditions a field interviewer might encounter. For that reason, it may be desirable to compare laptop computers in actual use before committing to purchasing a particular model. Field interviewers might be wise to carry spare batteries.

Storage. Most laptop computers offer several options for storage capacity. The Toshiba Tecra A11 comes standard with 320GB. The HP ProBook 4520s has several options of 250, 320, and 500 GB. The Fuji Lifebook E780 offers several options of different speeds (5400 rpm or 7200 rpm) and size options of 160, 320, and 500 GB. The Fuji also offers a 128GB solid state option. The Dell Latitude E5510 offers two sizes of 160 GB (5400RPM) and 320 G (7200 RPM).

Relevance to the Consumer Expenditure Survey. The field interviewers from the Census Bureau carry laptop computers to collect data in the Consumer Expenditure Survey.

At Westat, purchases of laptops for data collection occur after a great deal of pretesting with actual field staff. Westat evaluators have examined specialty laptops such as ruggedized and very small models.

Tablet Devices

Recently a number of tablet devices have become quite popular. The iPad by Apple, for example, has been the subject of many news stories. These devices are relatively small and light, as compared to laptop computers. They nonetheless offer many of the functions found in laptop computers. In addition, they offer a longer battery life than laptop computers can provide, have a touch screen, and depending upon the specific product come with integrated technologies like GPS, camera, video recording, audio recording and web connectivity.

These devices are quickly evolving. For this project, the research team reviewed these products: Apple iPad, HP Slate, Dell Streak (AKA Mini 5), and Lenovo U1. The matrix for these devices is in Appendix I.

Operating system. The operating systems of tablet devices determine which applications the devices can run, and which capabilities they can provide.

The iPad uses the Apple iOS operating system, which also runs on Apple's iPhone, iPad and iPod Touch. As noted earlier, Apple manages the App Store that currently serves as the only authorized way of distributing software for Apple mobile devices.

HP has recently announced its new product, the HP Slate. This device appears very similar to the Apple iPad in many ways. One major difference is that the HP Slate uses the Windows 7 operating system, which may be an advantage because existing Windows applications should be able to operate on this device. In principle, the HP Slate offers the best of all worlds: a small device with long battery life that runs widely used and trusted Windows applications. Very importantly, very few Windows applications were designed for a tablet computer or a touch screen. By contrast, the applications for other tablet devices were designed specifically for the tablet platform and a touch screen. Some Windows application may seem awkward when they run on the HP Slate because they were not designed for that device.

The Dell Streak uses the Android operating system. As noted in an earlier section on operating systems, Android is an open operating system with a large community of developers.

The status of the Lenovo U1 continues to change. It was initially planned to operate in two modes: in tablet mode using the Android operating system and in a desktop mode using Windows 7. Lenovo has not provided any official plan updates regarding this device.

Storage. Slate devices do not appear to sacrifice storage for size. The iPad provides several size options, including 16, 32 and 64 gigabytes. The HP Slate specifications appear to be for 64 gigabytes while the Dell Streak offers 16 gigabytes. Storage information regarding Lenovo's device is not yet released.

Camera. With the exception of the first version of the iPad, each of the reviewed tablet devices includes a camera. The pixel resolution varies among the devices. The Lenovo is planned to include a camera with 1.3 megapixel resolution. The Dell Streak has two cameras, one facing out and one facing forward. The next version of the Apple iPad is rumored to include two cameras as well.

Wireless connectivity. Each of the reviewed slate devices includes built-in Wi-Fi connectivity. Additionally, some include other wireless options. The Apple iPad offers an option for operation on the AT&T wireless network; this option requires purchasing the 3G version of the device and signing up for the AT&T data plan. The Dell Streak will operate on the T-Mobile network, requiring a subscription with T-Mobile.

GPS. The iPad and Dell Streak both have GPS technology built into the device. The HP Slate does not have a GPS embedded within the device; however, should one be needed, a GPS device can be attached to the HP Slate via its USB port.

To summarize the findings for GPS: All smart phones have GPS capabilities. The reviewed laptop computers require that a GPS device be added via the USB port. Tablets currently differ by manufacturer as to their GPS capability.

Multitasking. As noted earlier, multitasking enables the user to run several applications without needing to close one before starting to use the other. Multitasking is desirable because it saves the user from having to open and close applications when switching among them.

The most recent version the Apple iOS operating system, version 4.2, supports multitasking. Older versions did not.

The HP Slate will run Microsoft Windows 7 which is a multitasking operating system. However, the CPU of the HP Slate may not be able to support multitasking as easily as laptop and desktop computers typically can. When running many programs simultaneously, the HP Slate might become unacceptably slow.

Applications. The breadth of applications available for tablet devices is tied directly to the device operating system.

In the case of the iPad, the development community is very strong. There are currently more than 300,000 applications available for Apple devices in the Apple App Store.

The HP Slate uses Microsoft Windows 7 as its operating system, so many commonly used Microsoft applications should be able to operate on the device. However, most Windows 7 applications were built for desktop or laptop computers, which almost always have processors more powerful than those of the HP Slate. The tablet may operate slowly when running very resource-demanding programs.

HP has delayed shipping of HP Slate numerous times. Westat has ordered one for data collection trial purposes, the device due for delivery at the start of February is now scheduled to arrive in mid to late March.

The Dell Streak utilizes Android as its operating systems. As noted in the operating system section above, Android is an open operating system with a development community that continues to rapidly grow.

Battery life. The battery life for tablet devices is longer than that of laptop computers. The reason is that the CPUs of tablet devices are designed for a lower level of power consumption. Also, the storage on a tablet device is typically solid state with no moving parts. Tablet devices also do not need a cooling fan which consumes significant power in laptop computers. Also, the electronic chips that are used in tablet devices have relatively low power consumption.

The manufacturer's claims regarding battery life are included in Appendix I, but two examples can be provided here to provide a general picture of the range: The iPad is rated at 10 hours for video, 140 hours for audio, 1 month in standby mode. The Lenovo U1 was reported to be planned for 5 hours browsing time and 60 hours of standby.

Size and weight. Appendix I includes size and weight specifications for each device. The reviewed devices range from 6 inches to 9.5 inches in height, 3.1 inches to 7 inches in width and .39 inches to .58 inches in thickness. Tablets included in this study weigh between .48 and 3.8 pounds.

Relevance to the Consumer Expenditure Survey. Conceivably, the CAPI interviewers for the Consumer Expenditure Survey could use tablets rather than laptops. The tablets are lighter. The interviewers could hold them in their hands, without having to find a table or other surface in the respondents' homes.

The CAPI questionnaire is programmed in Blaise, which runs in a Windows environment. The HP Slate will run Windows 7. Testing would be required to determine whether the HP Slate can deliver an adequate level of performance when running Blaise applications like the Consumer Expenditure Survey CAPI questionnaire. Westat plans to perform such testing when the HP Slate arrives.

In addition, respondents could use tablets in much the same way that they would use smart phones as a data collection tool in the Consumer Expenditure Survey. Tablets and smart phones have many of the same capabilities. There are also some differences; for example, the initial version of the iPad does not have a camera. Tablets may be especially useful for respondents to respond to a brief set of questions about their purchases. Because tablets have relatively large screens, respondents may have little trouble reading and responding to questions.

Of course, not all respondents will be comfortable with a tablet. Also, unless the respondent already owns one, they could be an expensive data collection alternative.

Potential role of technology for data collection

The technologies reviewed in this project potentially could facilitate data collection in a redesigned Consumer Expenditure Survey. The technologies also potentially could reduce the extent to which the respondents rely on their memories to report data about their expenditures. This section summarizes how the reviewed technologies might be applied to collect data about expenditures of all kinds:

- Purchases by check
- Purchases by credit or debit card
- Purchases by PayPal or similar service
- Automatic fund transfers
- Purchases with receipts
- Purchases by cash with no receipts
- Purchases by money order or cashier's check
- WIC voucher or food stamp purchases
- Recurrent expenses or large, unusual expenses
- Purchases by gift and rebate cards
- Purchases of items labeled with barcodes
- Online purchases
- Returns and exchanges

This section of the report presents a potential data collection solution for a redesigned Consumer Expenditure Survey in which respondents employ technologies such as smart phones and software that incorporates some of the capabilities of financial software packages. These technologies can help collect only a portion of the data required by the Consumer Expenditure Survey. For that reason, this section also describes how a computer-administered questionnaire could supplement these technologies in a comprehensive data collection solution.

Purchases by check, credit card, debit card, PayPal, or automatic fund transfer.
When a respondent makes a purchase by check, credit card, debit card, PayPal, or automatic fund transfer, a record of that purchase appears in a data file that is almost always accessible online.

For check purchases, the record appears in the data file for the checking account after the check is cashed. The record contains the check number and the dollar amount.

For credit card purchases, the record appears in the data file for the credit card account. The record contains the date of the transaction, the payee, and the dollar amount.

For debit card purchases, the record appears in the data file for the relevant account at the bank, credit union, or other financial institution. The records are similar to those of credit card accounts.

For PayPal and similar accounts, the record appears in the transaction history file. The record contains the date, payee, and amount.

For ACH fund transfers, the record appears in the data file for the relevant account at the bank, credit union, or other financial institution. Automatic fund transfers can also occur from a PayPal account. The date, payee, and dollar amount would appear in the relevant data file.

There are several ways that respondents in the Consumer Expenditure Survey could access the data files for their accounts at banks, credit unions, or other financial institutions, or at PayPal and similar services. Respondents could simply log into the relevant financial web site and download the account data file. The file might be in QFX, QBO, OFX, or CSV format. PayPal files are only in CSV format, but many banks allow the user to select among several offered formats.

The financial software package Buxfer contained a feature called Firebux that automatically recorded the user's keystrokes as the user accessed an account file from a financial web site. Respondents could then click the Firebux icon to download the data file automatically. Firebux works only with the Firefox browser.

Respondents could also download their account files using some of the reviewed financial software packages. For example, the Mint software package allows respondents to select their financial institutions from a dropdown list. The respondents also enter the usernames and passwords that they use to access their account data for those financial institutions. Mint then automatically downloads the account data files and incorporates the data into a transaction register.

Mint was developed using the Yodlee SDK. The Mint software calls procedures in the Yodlee SDK to download account files. This ability to download account files from many financial institutions, PayPal and other financial services, and to assemble the data in a single transaction register is called "account aggregation."

Of course, it is possible to distribute Mint or other financial software package "out of the box" to respondents in the Consumer Expenditure Survey. However, the primary purpose of Mint and other financial software packages is to help users create and adhere to a budget, not to help users report expenditure data in the detail needed by the Consumer Expenditure Survey. Respondents would have to ignore the principal purpose of the software and focus solely on the account aggregation feature. Since so much of the user experience focuses on budgeting and avoiding overspending, respondents might find this software distracting. They might not be able to comfortably disregard all aspects of the software other than account aggregation. In short, the design of financial software packages does not meet the needs of the Consumer Expenditure Survey.

However, software developers could use the Yodlee SDK, or one of the other SDKs or APIs mentioned above in the section for financial software packages, to develop an application specifically for data collection in the Consumer Expenditure Survey. This application could give respondents a choice: they could select their financial institutions, and enter their usernames and passwords, so that the application automatically downloaded the account files on a regular schedule such as daily. Or, respondents who did not want to divulge their passwords this way could manually download their account files from the financial web sites and then import these files into the application.

The data files contain some but not all of the data required by the Consumer Expenditure Survey. For example, the data from a credit card file might show the total purchase at a supermarket but provide no information about the individual items purchased there. As described later, the respondents would have to provide the additional needed data.

Recurrent or large, unusual expenses. When respondents rely on their memory to report their expenses, they may well forget recurrent expenses. These expenses often are paid through ACH fund transfer from a bank or credit card account, so respondents might not think of them. Sometimes, they are paid by check but respondents may forget that expenses like rent or cable television fees must be reported in the Consumer Expenditure Survey. By downloading data files from their financial web sites, respondents might ensure that they do not forget recurrent expenditures, and have included the correct date and amount.

Similarly, respondents might forget to report an unusual expense such as a down payment on a major purchase, or an emergency home repair. Unless the respondent paid with cash, money order, or cashier's check, such expenses will appear in downloaded data files from financial web sites.

Purchases with receipts. Receipts typically contain descriptions and prices for items purchased. Respondents in the Consumer Expenditure Survey could run their receipts through a receipt scanner. The reviewed products included receipt scanners that are used in conjunction with software for managing expense reports for business travelers. Those products may not be

appropriate for the Consumer Expenditure Survey "out of the box." However, software developers could create an application specifically for the Consumer Expenditure Survey. That software could produce an image of the scanned receipt in a format such as PDF, JPG or TIF, and then apply OCR to extract data from the receipt.

Some of the reviewed products such as Shoeboxed allow users to photograph a receipt rather than scan it. The manufacturers of these products claim that their OCR engine can turn the image into text. As mentioned above, testing would be needed to determine whether respondents can use smart phone photography reliably this way.

Receipts contain only a portion of the data required by the Consumer Expenditure Survey. As described later, respondents would have to provide the additional needed data.

Purchases by cash with no receipts. There are several ways that respondents could create a record of their purchases when there was no receipt. First, they could use a smart phone to photograph the place of the purchase, or the items purchased. The photograph would be time and date stamped. Of course, this photograph would contain no details about the items purchased, such as their costs. However, a photograph creates a record, helping to ensure that the respondent does not forget to report the purchase. A photograph also could later serve as a recall aid, helping to jog a respondent's memory about details about the purchase.

Alternatively, the respondent could record a short audio clip about the purchase. For example, the respondent might use a smart phone to record a message like "I bought an umbrella from a street vendor for five dollars for my own use." The audio file could be time and date stamped. Like a photograph, an audio clip could serve as a recall aid. One of the products reviewed, The Expense Tracker, uses such audio messages. Speech recognition software has recently become very powerful. However, at the current time speech recognition software could not reliably turn such audio files into text. The Expense Tracker, for example, requires the messages to be in a very restricted format for the speech recognition engine to work. In future years, speech-to-text software will be less error prone.

Another possibility is that the respondent could use a smart phone to text or email information about a purchase. The message would be time and date stamped. For example, the respondent might text "Pretzels, vending machine, $1."

Yet another possibility is that the respondent type in information about a purchase using a smart phone application developed specially for the purpose. That application might record the following:

- The date and time of the purchase, recorded automatically by the smart phone
- The place of the purchase

- Information about the items purchased and the price. This information could not be extensive, because the respondent may not be able to spend much time typing on the smart phone at the place of the purchase

Of course, photographs, audio clips, text or email messages, and data entry screens on smart phones can provide some but not all of the data required in the Consumer Expenditure Survey. As described later, respondents would need to provide the additional needed data.

Purchases by gift and rebate cards, food stamps, WIC vouchers, money orders, or cashier's check. Both gift cards and rebate cards are prepaid with a set amount of funds. Gift cards are typically honored by only one merchant. For example, a gift card could be worth $25 which could be spent only at Starbucks. Rebate cards physically resemble ordinary credit cards, but they cannot be used to incur charges beyond the prepaid amount.

Users usually are given access to a vendor-specific web site to view a list of transactions made with individual gift or rebate cards. However, these web sites generally do not provide a way for users to download a file containing those data.

Similarly, purchases by food stamps, WIC vouchers, money orders, or cashier's check do not appear in a file that users can download.

Respondents in a redesigned Consumer Expenditure Survey would have to treat these purchases as though they were cash purchases. They could enter data using the receipts. If there were no receipts, they would have to treat the purchases as cash purchases with no receipts.

Purchases of items labeled with barcodes. Respondents could scan the barcodes on the items that they purchased, when those items carried barcodes. As described earlier, they would point their smart phone at the barcode, check that the image of the barcode appeared on the screen, and then click a button on the screen to take a photograph. Of course, barcodes provide only the identity of the product. As described later, respondents would have to provide the additional needed data.

Online purchases. With some online purchases, the merchant sends the buyer an email with information about the purchase. These email messages vary from one vendor to another, but they should always contain a description of the items purchased, the price, the vendor, and the date.

With other online purchases, the merchant does not send an email, but does provide a web page that confirms the purchase and displays information about the purchase. For example, some utilities such as an electricity provider offer a payment confirmation on a web page but not in an email. All contemporary web browsers have a feature for emailing the web page that the browser currently displays. Respondents could use that feature to email the purchase confirmation.

As described below, these confirmations of online purchases could help respondents report all the needed data about their online purchases.

Returns and exchanges. Returns and exchanges may appear in credit and debit card data along with purchases. When respondents download files from the web sites of their financial institutions or of PayPal or similar service, the returns and exchanges appear in the files. However, the files will not display how particular returns and exchanges are associated with particular purchases. For example, an account file could show a $25 credit from Macy's, but the file would not show that the credit was for the return of a particular item that was part of an earlier $100 purchase.

When returns or exchanges involve an earlier cash purchase, they are usually documented with a receipt. As mentioned above, the receipt could be scanned or photographed so that the information can be extracted using OCR software.

When returns or exchanges are simply not documented with a receipt, or in credit card data, or in any other way, they can be recorded in the same manner as cash purchases with no receipt, as discussed above. For example, respondents could photograph the returned merchandise, make an audio file, or send a text message.

Of course, for any of these techniques, respondents would have to provide further information about returns and exchanges to meet the requirements of the Consumer Expenditure Survey. A method for obtaining that further information is described next.

Computer-assisted self interview. In summary, respondents could employ many techniques to supplement their memories when they report data in the Consumer Expenditure Survey. The recall aids could be in many forms:

- Data files downloaded from banks, credit card companies, PayPal, or other financial institutions, showing for each transaction: the date, dollar amount, and in some cases the payee
- Data that the respondents manually entered into their smart phones, using an application developed specially for the Consumer Expenditure Survey
- Text messages about purchases. The respondent could enter a description of the items purchased, the price of each item, and other data
- Email messages about purchases. Again, the respondent could enter a description of the items purchased, the price of each item, and other data. Or, online merchants might send purchase confirmation emails
- Web pages confirming online purchases
- Barcode data that the respondents scanned into their smart phones. These barcode data could be converted into a list of items purchased

- Files containing scans, or possibly photographs, or receipts. OCR software would convert those scans or photographs into text files
- Photographs of the place where a purchase occurred, or of the merchandise purchased
- Audio clips containing information about purchases. The respondent could record a description of the items purchased, the price of each item, and other data

Of course, these memory aids would rarely contain all of the information required by the Consumer Expenditure Survey. For example, credit card data files show the total amounts for purchases, not the individual items purchased. An additional method is needed to collect the rest of the data. That method could be a questionnaire.

Respondents could send their data to a central system. That is, they could email photographs, audio files, downloaded account data files, purchase confirmation web pages, and the other recall aids to a repository that had been set up for each individual respondent.

After having sent these data to the central system, a respondent could log in to a web site built specially for the Consumer Expenditure Survey. The web site would administer a Computer-Assisted Self Interview (CASI) to collect all the needed data about each purchase.

The CASI system might put all the data that it received into chronological order. That is, the CASI system software would arrange all of the entries in the credit card and checking account data files, photographs, audio clips, text messages, email messages, online purchase confirmations, and lists of products obtained from barcode scans into chronological order starting with the first day of the reporting period. The CASI system would then question the respondent about each item in the chronological data.

CASI questions about purchases listed in data files downloaded from banks, credit card companies, PayPal, and other financial institutions. The CASI system would display the date and dollar amount of the purchase. The CASI system could ask the respondent for the rest of the needed data. For example, the CASI system would ask the respondent to categorize the purchase into one of the four Consumer Expenditure Survey categories (food away from home, food for home consumption, clothing, and other). It could then present a series of questions, asking the respondent to enter any further data that the survey requires.

CASI questions about purchases listed in scanned receipts. The CASI system could recognize that an image was a scanned receipt, and, using OCR routines, convert the image into a text version of the receipt. The system could then apply routines that parsed this text in order to identify the individual purchases listed. Existing software for tracking expenses, reviewed above, does not consider the individual items in a receipt; it locates and captures only the total amount of the purchase. For the Consumer Expenditure Survey, the CASI system will need to capture the individual items. For example, a supermarket receipt might contain the line "Apples…1.50." The CASI system could ask the respondent to verify that "Apples" was an adequate description of the purchase, and that $1.50 was the amount paid. The CASI system

would ask for the additional data required by the Diary Survey, such as whether the food could be classified as "fresh," "frozen," "bottled/canned," or "other."

For this software to work, it must be programmed to handle purchases that are listed on more than one line on the receipt. For example, a single purchased item might be listed on two lines, the first line being "Apples…1.50," and the second being ".75 lb at 2.00/lb." Or, the second line might be, "Bonus card discount 1.00." The software would need to have the capability to recognize which lines of the receipt were the ones that revealed the identity and the price of the purchased merchandise. This software therefore would have to apply the methods of computational linguistics or natural language processing. The success of this approach depends upon the quality of the receipt scans, the OCR software, and the software that finds and displays the purchase description and price printed on the receipt.

CASI questions about lists of items generated from scanned barcodes. Lists of items generated from scanned barcodes would contain only the identity of the items. They would not contain price data about price or any of the other data required by the Consumer Expenditure Survey. The CASI system would therefore ask the respondent to enter the price for each item. The system could also ask the respondent to classify each item into one of the four Consumer Expenditure Survey categories, and to respond to further questions about each item.

CASI questions about purchases reported via a smart phone application developed specially for the Consumer Expenditure Survey. The CASI system would present questions about each item purchased, in order to collect all the needed data.

CASI questions about purchases reported via photographs, audio files, text messages, or emails. The CASI system would first show the photograph, play the audio file, or display the text message or email. The respondent would respond to questions about the purchase. In this way, the photograph, audio file, text message, or email would serve as a mnemonic to help the respondent recall the purchase. The CASI would ask questions to collect the needed data about the purchase.

Potential advantages. The system described has a number of advantages. First, the quality of the data collected by this system relies primarily on documentation of various sorts, not on the accuracy of the respondents' recall abilities.

Second, the described system gives respondents multiple methods to report their purchases. Respondents who are most comfortable with texting could use that method to report their purchases. Respondents who were most comfortable with barcode scanning or audio recording or photography or using a document scanner could use any of those methods.

Third, since the system involves a computer-administered questionnaire, it can check that the data appears complete and plausible. The software could detect omitted data. For example, if a respondent did not answer a question about whether purchased apples were "fresh," "frozen,"

"bottled/canned," or "other," the software could repeat the question. Better yet, it could be programmed to apply logic. For example, it might simply ask the respondent to confirm that the apples were fresh, not frozen or canned.

The software might also detect respondent mistakes. For example if a respondent erroneously reported a $90 purchase of apples, the software might ask the respondent to confirm that this implausible entry was accurate.

Potential disadvantages. The system described also has a number of disadvantages. First, the system would need a method to avoid duplicate reports of any purchase. For example, a respondent might report a purchase by emailing an image of a scanned receipt. That same purchase might appear in a downloaded credit card data file. Some financial software packages can reconcile data from multiple sources. That capability will be crucial for the Consumer Expenditure Survey.

Replacing or supplementing paper diaries with new technologies for data collection conceivably might introduce new sources of measurement error. Most obviously, some people lack the computer skills or a willingness to use computers or smart phones. Those people may prefer to use the paper and diaries. This situation would turn the Consumer Expenditure Survey into a multi-mode survey and potentially introduce "mode effects." "Mode effects" refer to bias caused by the methods used to collect the data. Conceivably, the data for respondents who use paper and pencil might systematically differ from the data for respondents who use smart phones or other technology purely because of the data collection mode. A large body of research has examined the problem of mode effects. The problem might be especially important if only the more wealthy respondents elected to use computers and smart phones.

In addition, many people lack bank or credit card accounts and therefore cannot download any data from financial institutions; they would have to enter all their expenses manually, as cash transactions. These "unbanked" individuals are disproportionately young, male, indigent, Latino, and African American[1]. Data collection software could therefore potentially create a systematic bias in the data relating to these demographic characteristics of the respondents.

Very importantly, technology can malfunction or be frustrating to operate. For example, OCR software could make errors when it reads receipts, irritating respondents who have to repeatedly correct the mistakes. Barcodes on wrinkled paper may not scan correctly, making respondents impatient with the barcode system.

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[1] Blank, R.M., & Barr, M.S. (Eds.). (2009). *Insufficient funds: Savings, assets, credit, and banking among low-income households.* New York: Russell Sage Foundation

Technology also may introduce human factors issues. For example, some respondents may find the task of scanning a receipt to be time consuming and burdensome. They might think that writing information in a diary is much less laborious than scanning the receipts. They might deliberately skip some receipts in order to shorten the task. Other technologies may have the same drawback. Data collection staff may not be able to predict which specific respondents will have problems with any particular technology.

Asking respondents to photograph receipts could also introduce human factors concerns. Many people will have difficulty holding the smart phone still enough to prevent the photograph from being too blurry for the OCR software to operate well. Also, some receipts are difficult to photograph. Supermarket receipts can be two or three feet long by three inches wide. Photographing the entire receipt in one frame could distort the text so that OCR software cannot read it accurately. Taking several photographs of a single receipt could create insurmountable problems managing the output of the OCR software.

The need for further research. For smart phone or personal computer applications to be suitable for data collection in the Consumer Expenditure Survey, they must reduce the measurement error associated with the current paper-and-pencil data collection methods. They must not merely replace problems associated with the paper diaries with different problems associated with technology.

Any new technology should be tested with respondents with a wide range of demographic characteristics and levels of experience and comfort with technology. The tests should evaluate the accuracy and completeness of the collected data, as well as the reactions of the respondents. A great deal of testing would be needed to ensure that the data collection methods of the Consumer Expenditure Survey successfully made the transition from paper-and-pencil methods to technology-based methods. The Consumer Expenditure Survey could serve as the model for all survey researchers planning to adopt new technologies.

APPENDICES

APPENDIX A:

Financial Software Products

Appendix A

Financial Software Products

Financial Software Product	Website	Automatic Data Capture	Cash Expenditures	Transaction Reconciliation	Splitting	Categorization	Custom Categories
AceMoney	www.mechcad.net/products/acemoney	✓	✓		✓		✓
BankTree Personal	www.banktree.co.uk		✓	✓	✓	✓[2]	✓
Budget Express	budgetexpress.demarque.com/en		✓	✓		✓	✓
Bundle	www.bundle.com	✓[4]	✓		✓	✓	✓
Buxfer	www.buxfer.com	✓[5]	✓[6]	✓	✓	✓[7]	✓
ClearCheckbook	www.clearcheckbook.com		✓		✓		✓
Expense Tracker	www.theexpensetracker.com		✓[11]			✓	
Fortora Fresh	www.fortora.com	✓[12]	✓	✓	✓		✓
iCash	www.maxprog.com/iCash.html		✓	✓	✓[13]		✓
Mint	www.mint.com	✓	✓[16]		✓[17]	✓	✓
Moneydance	www.moneydance.com	✓	✓	✓		✓[19]	
Money Dashboard	www.moneydashboard.com	✓[22]				✓	✓[23]
moneyStrands	money.strands.com	✓	✓		✓	✓	✓
Mvelopes	www.mvelopes.com	✓	✓	✓	✓	✓	✓
Quicken	quicken.intuit.com	✓	✓	✓	✓	✓	✓[25]
RichOrPoor	www.shortcutsoft.com		✓	✓	✓		✓
Rudder (discontinued)	www.rudder.com	✓[26]					
Thrive	www.justthrive.com	✓[28]		[29]		✓[30]	
Yodlee MoneyCenter	www.yodlee.com/consumer.html	✓	✓	✓	✓	✓	✓
You Need A Budget 3	www.youneedabudget.com		✓		✓		✓

Appendix A (cont.)

Financial Software Products

Financial Software Product	CE Categories	Alcohol Subtotal	Tagging by Category	Abbreviations	Data Export	Instructions	Returns & Exchanges	Calendar	SDK
AceMoney	✓				✓[1]			✓	
BankTree Personal	✓				✓[3]			✓	
Budget Express								✓	
Bundle	✓								
Buxfer	✓		[8]		✓			✓	✓[9]
ClearCheckbook	✓				✓[10]			✓	
Expense Tracker									
Fortora Fresh	✓								
iCash	✓	✓[14]			✓			✓[15]	
Mint				✓	✓[18]			✓	
Moneydance					✓[20]			✓	✓[21]
Money Dashboard	✓				✓				
moneyStrands					✓[24]				
Mvelopes	✓				✓			✓	
Quicken				✓	✓			✓	
RichOrPoor	✓								
Rudder (discontinued)								✓	✓[27]
Thrive								✓	
Yodlee MoneyCenter					✓			✓	✓[31]
You Need A Budget 3	✓				✓[32]			✓	

Appendix A (cont.)

Financial Software Products

Footnotes

1. AceMoney can export data in HTML, TXT, QIF, and CSV formats.
2. With Bank Tree Personal, the user can categorize expenditures manually. Afterward, the system automatically assigns expenditures to the same payee into the same category.
3. Bank Tree Personal can export data in OFX, QIF, CSV, and XLS formats.
4. Bundle.com can automatically download data from bank and credit card accounts, but not from investment accounts; this feature is planned for the future. Bundle.com is the result of a collaboration among Microsoft, Morningstar, and Citi. Its main feature is social networking. It presents data about how people in various parts of the US tend to spend their money.
5. Buxfer has many features that are tailored for households in which roommates share expenses and manage their money separately.
6. Buxfer has an unusual feature: Users can email or text data about transactions to an address that they receive from Buxfer. These transactions are then recorded in the transaction history.
7. With Buxfer, the user can specify rules, such as a rule requiring the system to categorize an expenditure as "food" if the word "pizza" appears in its name.
8. With Buxfer, the user can add an image of a receipt to a recorded transaction.
9. Buxfer has an API. Calls are in the format https://www.buxfer.com/api/[command].[format]?token=login_token[&params]. Sample code is provided in Ruby, Python, PHP and Perl.
10. ClearCheckbook exports in CSV, QIF, OFX, and QFX formats.
11. With Expense Tracker, when users incur an expense, they telephone a speech recognition system and state the category name or number, and the amount of the expense. The user may also text this information to an address they receive from Expense Tracker, or enter the information online. The expense then appears in the user's expenditure list.
12. Fortora Fresh can automatically import data from savings and checking accounts but not from investment or credit card accounts; for those, the user must download a file from the financial institution and then import it. Fortora Fresh automatically imports data from banks using a system called Direct Connect, which many banks do not support.
13. iCash actually allows users to perform an action that is the opposite of splitting: The user can enter several transactions and then group them together. The system adds the amounts of the individual component transactions to compute the amount of the total transaction.
14. With iCash, the user could enter the alcohol and non-alcohol components of the meal as separate transactions, and then group them together.

Appendix A (cont.)

Financial Software Products

15. iCash supports recurrent transactions. It also allows the user to create a list of "favorite" transactions. The user can enter a transaction from that list simply by clicking one of the favorites.
16. With Mint, cash transactions must be attributed to a recent cash withdrawal from an account, such as an ATM withdrawal from a checking account. Mint does not support cash obtained in other ways, such as a gift, unless that cash is entered into and then withdrawn from an account.
17. Mint allows users to split transactions drawn from an account, but not cash transactions, since they were already split from cash withdrawals. For example, a user could split a $100 cash withdrawal into a $25 expenditure at Target and a $75 expenditure at Walmart. The user could not then split these expenditures any further to note the individual items purchased.
18. Mint exports only in CSV format.
19. Moneydance may allow users to create custom categories in future versions.
20. Moneydance exports only in CSV format.
21. Moneydance has a developer's kit that allows outside developers to create new functionality using Python.
22. MoneyDashboard is designed primarily for British users. It currently does not support cash transactions or split transactions or a calendar for recurring expenditures, but those capabilities are planned for future versions.
23. In MoneyDashboard, categories are called "groups" and sub-categories are called "tags."
24. moneyStrands exports in CSV and PDF formats only.
25. Quicken allows users to merge and delete most categories, but certain categories cannot be deleted. Only categories that have at least one transaction can be merged.
26. Rudder sent a daily email to users, showing the status of all of their checking and credit card accounts, along with a "spendmeter" indicating whether they needed to scale back their spending. The product did not attempt to track individual expenditures, and did not consider expenditures in specific categories. It was intended only to provide an overview of cash flow with minimal effort on the user's part.
27. One review of Rudder stated that the developers of the product hoped to allow third parties to develop "widgets," which are graphs, charts, and tables that show financial activity.
28. Thrive is a product of LendingTree intended for 20 to 30 year old users who are not accustomed to budgeting. It provides minimal expense tracking, but offers more advice than most other products. It assumes that the vast majority of the user's expenditures are transacted with a credit card, not cash or check.

Appendix A (cont.)

Financial Software Products

29. The FAQ section of Thrive indicates that the developer intends eventually to add a feature whereby manually entered transactions are reconciled with credit card statements.
30. Thrive automatically categorizes transactions. Moreover, it records the way that users categorize transactions and automatically categorizes future transactions into the categories that the user selected.
31. Yodlee offers an API that enables developers to create new Adobe Flex-based applications. Many of the other financial software products were created using the Yodlee API.
32. You Need A Budget exports in CSV and QIF only.

Explanations of the Column Labels

Automatic data capture. A checkmark denotes that the financial software product can automatically import data from checking, debit card, credit card, PayPal, investment or other accounts. The users provide the user name and password for each account. The product then downloads the data periodically from the web site of each financial institution. No checkmark denotes either that the product does not use data from such accounts (true for only Expense Tracker) or that the user must import the data manually. The user downloads an OFX, QIF, CSV, or QFX file from the web site of the financial institution and then uploads that file to the financial software product.

Cash expenditures. A checkmark denotes that the financial software product allows users to manually enter expenditures that are paid in cash rather than with a credit or debit card or check. The lack of a checkmark denotes either that users can not enter cash transactions at all or that the user must enter cash transactions as though they were bank or credit card account transactions. The user must split cash withdrawals from those accounts into the purchases that the user made with the cash. The user has no way of logging transactions made with cash obtained without a cash withdrawal, such as with cash obtained as a gift.

Transaction reconciliation. A checkmark denotes that the software can reconcile check, debit card, or credit card transactions with manually entered expenditures automatically. The software matches the date and amount of the expense that the user entered manually with the date and amount of the expenditure recorded in the account. The software then marks the expense as reconciled. The lack of a checkmark denotes that the user must reconcile expenses manually. The user compares manually entered expenses with those listed on an account summary from the financial institution. Products that reconcile automatically generally permit users to reconcile manually also.

Appendix A (cont.)

Financial Software Products

Splitting. A checkmark denotes that the software allows users to split individual expenditures into smaller component expenditures. For example, an expenditure at Walmart can be split into a clothing component and a food component. The lack of a checkmark denotes that the software does not permit the user to split expenditures.

Categorization. A checkmark denotes that the software automatically categorizes credit and debit card expenditures into categories. For example, an expenditure at McDonald's is automatically categorized as "food." The software typically categorizes only certain expenses and uses only certain categories. Users must manually correct any errors that the software commits. Users must also manually categorize expenditures that the software was unable to categorize. Some software products allow the user to set rules. For example, the user could specify that all expenditures containing the work "pizza" be categorized as "food." The lack of a checkmark denotes that the user must always manually categorize all expenditures.

Custom categories. A checkmark denotes that the software allows users to create, delete, and change the name of categories or sub-categories. The lack of a checkmark denotes that the software does not offer that flexibility.

CE categories. A checkmark denotes that users could, if they wanted, set up just the four categories that are used in the diaries for the Consumer Expenditure Survey: 1. Food and drinks away from home; 2. Food and drinks for home consumption; 3. Clothing, shoes, jewelry, and accessories; and 4. All other products, services, and expenses. The lack of a checkmark denotes that users are not permitted to add, delete, or customize categories at all or that they are not permitted to delete some categories that are not among these four.

Alcohol subtotal. The CE diary requires respondents to record both the total cost of a meal away from home, including any alcoholic beverages, and a subtotal for just the alcoholic beverages. A checkmark indicates that the software allows the user to record both the total meal expenditure and the alcohol subtotal. This capability is different from the "splitting" capability. The splitting capability does not allow the user to record a total and a subtotal. It merely allows the user to record a "meal non-alcohol" subtotal and a "meal alcohol" subtotal; the overall total is not recorded. Only one product (iCash) has the "alcohol subtotal" capability.

Tagging by category. A checkmark denotes that the software allows users to enter the information needed for the Consumer Expenditure Survey about each expenditure. The CE diary requires respondents to enter different data about different categories of expenditures. For food away from home, the respondent must classify the expenditure as fast food, full service, vending machines, or cafeteria; the respondent must classify the alcohol portion as wine, beer, or other. For food for home consumption, the respondent must classify the expenditure as fresh,

Appendix A (cont.)

Financial Software Products

frozen, bottled/canned, or other, and whether the food expenditure is for someone not on the respondent's list. For clothing, the respondent must classify the expenditure as for male or female, for age under 2, 2-15, or 16 and over, and whether the clothing expenditure is for someone not on the respondent's list. For all other purchases, the respondent must indicate whether the expenditure is for someone not on the respondent's list. A checkmark indicates that the user can tag each expenditure according to those criteria. That is, a checkmark indicates that the software permits the user to set up a separate set of tags for each expenditure category. For example, the user would have to choose "wine," "beer," or "other" only for alcohol beverage expenditures; those choices would not be offered for other expenditures, such as clothing. No financial software product had that capability. The lack of a checkmark indicates either that the user cannot tag expenditures at all, or that when the user creates a tags, they apply to every expenditure, and cannot be restricted to just expenditures in specific categories. Many products allow the user to add notes to a transaction; this capability is not sufficient for a checkmark.

Abbreviations. Credit and debit card files often contain abbreviations. A checkmark indicates that the product resolves abbreviations into meaningful text. For example, when the product encounters "TGT" it displays "Target." Only two products, Mint and Quicken, advertise this capability. Both are products of Intuit. The lack of a checkmark indicates that the software does not resolve abbreviations. Many products, however, allow the user to create a list of vendors and to assign a vendor from that list to any expenditure.

Data Export. A checkmark indicates that the user can export expenditure data to Excel, CSV, QIF or other format file. The lack of a checkmark indicates that the software does not allow the user to export expenditure data.

Instructions. A checkmark indicates that the user can customize the software so that it presents instructions. For example, the Consumer Expenditure Survey requires the respondent to enter the total cost without tax for expenditures in the category "all other products and services." Instructions could help ensure that the user remembers to exclude tax from the amount of the expenditure. No product has this capability.

Returns & exchanges. A checkmark indicates that the user can note that a purchased item was returned for a refund or an exchange, and the user can record the amount of the refund or the cost of the item acquired in the exchange. No financial software product has this capability. Many products can note returns, but those returns cannot be associated with a particular purchase. That is, the expenditure list might include "Walmart, credit, $50" in the "clothing" category, but there would not be any indication of which specific clothing purchased at Walmart was returned.

Appendix A (cont.)

Financial Software Products

Calendar. A checkmark indicates that the software includes a calendar or other means for displaying recurring payments such as mortgage payments. The lack of a checkmark indicates that the software records recurring expenditures, but it handles them exactly like any other expenditure.

SDK. A checkmark indicates that a Software Development Kit or Application Programming Interface (API) is available that enables developers to add or customize the functionality of the software.

Note: Two products that we intended to review, Wesabe and Kublax, are defunct and not included. Rudder is also defunct, but it is included in the matrix because several reviews and descriptions of it are still available on the Internet.

APPENDIX B:

Mobile Carriers

Appendix B

Mobile Carriers

Criteria	ATT	Verizon	Sprint/Nextel	T-Mobile
Mobile Devices Supported. Will identify which mobile devices included in this market scan are available through each of the mobile carriers included in the market scan.	iPhone 4, iPad 3G, RIM Torch 9800	DroidX, iPad (non 3G) (Rumors of iPhone to be coming)	HTC EVO 4G	None currently analyzed
Mobile voice technology standard. Which voice mobile technology is currently employed by the carrier? (GSM, CDMA, Other?)	GSM	CDMA	CDMA/iDen	GSM
Mobile data technology. Which mobile data technology is currently employed by the carrier? (HSPA/UMTS, EVDO, Other?)	UMTS /HSPDA	EVDO	EVDO for 3G.	UMTS/HSDPA
4G Mobile Data Strategy. Does the Carrier have a 4G mobile data strategy? If so, which technology is planned to be employed? (WiMAX, LTE, Other Comments/Specify)	LTE Roll out planned to begin 2011	LTE Roll out currently underway	4G WiMAX (Clearwire) being rolled out in select cities. Possible consideration of LTE for Future rollouts	Rolling out HSPA+ as a 4 G solution
Price Plans. What are the general monthly price plan options for voice service with the carrier? (Specify)	Offers monthly Individual Plans (starting at $60 for 450) , Family Plans with shared family minutes, Prepaid Plans, Data Plans and Corporate plans. Plans generally include • Unlimited calling to other AT&T wireless customers with Mobile to Mobile while in the U.S. • No roaming or long distance charges in the U.S. • Saving unused minutes with Rollover® • Get unlimited calling to and from your favorite U.S. phone numbers at no extra charge with A-list. Details • Unlimited calling on Nights and Weekends for most plans See Price Plan link below for detailed information	Offers monthly Individual Plans (starting at $40 for 450 , Family Shared minute Plans, Prepaid Plans, Mobile Broadband and Corporate plans. All plans include Unlimited Mobile-to-Mobile Calling, No Domestic Roaming or Long Distance Charges Unlimited Night and Weekend Minutes See Price Plan link below for detailed information	Offers several plans: Simply Everything and Simply Everything Family - Provides unlimited calling and data plans for individuals and Family (starts at $90/mo/line) Everything Data and Everything Data Family - Provides unlimited data use (web email texting) but limited minutes on voice calls. Everything Messaging and Everything Messaging Family - Provides unlimited messaging but has limits on voice and data. See Price plan link below for further information	Offer several monthly plans for Individuals and Families Talk plans begin at $60/mo Other Plans include Talk + Text, Talk + Text + Web. Price plans range depending upon number of minutes of talk time or amount of data usage. See Price Plan link below for further details

Mobile Carriers

Criteria	ATT	Verizon	Sprint/Nextel	T-Mobile
Price Plans Discounts. Does the carrier offer price plan discounts (e.g. Family Plans etc..)? If so specify.	Y - Offers Shared minute calling plans as well an in Network free calling plans. Some plans allow unused minutes to be rolled to next month	Y - Offers shared minute plans. Some plans allows for prespecified out of network free call numbers. Offer lower cost for additional lines.	Y - Offers lower cost per additional lines for family plans. Provides Options for early start of free night rates	Y - Offers shared minutes plans and lower cost for additional lines.
Prepaid Options. Does the carrier offer prepaid service plans?	Y	Y	Y	Y
Carrier Coverage. Does the carrier offer nationwide coverage? Where available access to geographical coverage information will be provided.	Y	Y	Y	Y
Coverage map link	http://www.wireless.att.com/coveragevi ewer/#?type=voice	http://www.verizonwireless.com/b2c/ CoverageLocatorController?requestty pe=NEWREQUEST	http://coverage.sprint.com/IMPACT.jsp	http://coverage.t-mobile.com/default.aspx?MapType=Data
Price Plan Link	http://www.wireless.att.com/cell-phone-service/cell-phone-plans/index.jsp	http://www.verizonwireless.com/b2c/ store/controller?item=planFirst&actio n=viewPlanOverview	http://shop.sprint.com/NASApp/onlinestore/ en/Action/DisplayPlans?filterString=Business _Plans_Filter	http://www.t-mobile.com/shop/plans/Cell-Phone-Plans-Overview.aspx

APPENDIX C:

Mobile Device Operating Systems (OS)

Appendix C

Mobile Device Operating Systems (OS)

Criteria:	Apple iOS	Android	WebOS	Blackberry	Windows Mobile
Mobile devices utilizing the OS. Are the mobile devices included in the market scan using this OS? If so, which?	iPhone 4, iPad	Motorola DroidX, HTC EVO 4G	N	RIM Blackberry Torch 9800	N
Target Market. Is the target market for this OS consumer or commercial?	Initially Consumer focus. Emerging quickly for Commercial use. Security and Business capabilities & applications becoming more a focus of Apple.	Primarily Consumer, Beginning to Emerge for commercial and business applications - but still early stage	Both - but currently in decline in both consumer and business markets. HP hopes to reignite	Primarily Commercial	Primarily Commercial. Currently retired. New OS Windows - Phone replacing Windows Mobile..
Development community and tools. Is there a community of developers and available tools for application development?	Y - An SDK is available from Apple. And there is a strong development community for the iOS environment. Developers need not develop or host their own distribution sites as applications (considered to be legitimate by Apple) that run on the device are distributed through the App store and iTunes. The development community continues to grow rapidly.	Y - A development environment and tools exist. The development environment is very open (plug in for the open Eclipse IDE development environment is available), and application distribution is also open with many options. This development community is rapidly growing and maturing. An Google/Android marketplace exists for distribution of applications.	Y - An SDK and development community do exist. Plugins for the open Eclipse IDE exist. HP continues to support development forums. However because the devices using this OS have lost some market share to others, this development community is not growing as quickly as the other communities are. This could change should HP develop a slate/tablet or more handheld devices that use this OS.	Y - Blackberry provides a plugin for the open Eclipse IDE and an SDK exists to enable development. The community is typically more business application focused and their doesn't exist the breadth of applications as exists for some of the other environments largely due to the lack of a broad distribution model as exists with (for example) the Apple app store.	Y - Windows Mobile was based on the Windows CE (Compact Edition) OS. A development environment has existed. Windows also has developed a Windows Marketplace for Windows Phone OS application distribution.

Appendix C (cont.)

Mobile Device Operating Systems (OS)

Criteria:	Apple iOS	Android	WebOS	Blackberry	Windows Mobile
Are there applications available for the OS. Is there a range of applications readily available for the OS, and is it expected to continue to grow? Yes, No, Comments/Specify:	Y - Applications can be sold and distributed through the Apple App Store and itunes. As a result of the growth of the development community largely due to the ease of application distribution the spectrum of available applications - both consumer and business targeted - is large and continues to grow	Y - The community continues to grow and the number of applications being developed and becoming available is increasing at a fast pace. This is largely due to the openness of the environment that Google has created, allowing for applications to more easily be able to take advantage of device capabilities for the applications being developed.	Y - However due to the fact that the market of devices using this OS has diminished, fewer applications appear to be available than ones available for other device operating systems.	Y - Applications are available. RIM/Blackberry has historically been known to be more of a business oriented device - less of a multimedia capable device, as a result applications are typically more business focused. as primarily being an email device	Y - Applications were available for this environment - but they were typically business oriented as the devices were more business oriented devices.
Adoption and growth. Does it appear from the market that this OS will continue to grow and evolve? Yes, No, Comments/Specify:	Y - iOS supports iPhones and iPads. Although somewhat of a closed environment, Apple's app store provides a platform for ongoing development and the availability of both consumer and commercial applications. Apple continues to focus on enterprise needs including security.	Y - Android is an open environment resulting in the increased availability of both consumer and commercial applications that are causing the use of this OS to evolve and grow. While currently primarily used for smartphone like mobile devices, the release of Slate and iPad like devices are well underway (e.g. Samsung Galaxy Tab)	Unknown. Currently WebOS is losing Market Share. HP's plans are unclear	Y - Because of its deeps roots in the commercial market RIM continues to be a contender	N - Windows Mobile is no longer being promoted. A new operated named Windows Phone has recently been released in November that is not rooted in the windows CE platform. The OS appears to be more like the Android and iOS graphical environment, however It will take some time to see how the market for this OS matures HTC, Samsung, LG and others have announced phones that operate the new OS. T-Mobile and ATT have recently started carrying some Windows Phone 7 devices. Verizon and Sprint wont likely begin offering phones on this new OS until 2011. Reviews indicate that the OS is promising when compared to others like Android and Apple iOS.

Appendix C (cont.)

Mobile Device Operating Systems (OS)

Criteria:	Apple iOS	Android	WebOS	Blackberry	Windows Mobile
Does the OS support multitasking. Does OS provide an ability to multitask – allowing user to leave one application, invoke another (e.g. image capture) and return to the original application as though uninterrupted?	Y - as of iOS 4	Y	Y	Y	Y
Multimedia support. Does the OS support multi-media capabilities (e.g. camera, audio, video, etc)?	Y	Y	Y	Y	Y
Website.	http://www.apple.com/ios/	http://www.android.com/	http://developer.palm.com/	http://us.blackberry.com/apps-software/	For windows phone -> http://marketplace.windowsphone.com/Default.aspx
Unique Features. Does the OS provide any additional unique features that may be relevant to CES?	Possibly - Because of the size of the development community, ability to identify and develop special purpose applications, or the ability to string together existing applications may be easier for CES use	Possibly - Because of the size of the development community, ability to identify and develop special purpose applications, or the ability to string together existing applications may be easier for CES use	None identified at this point. May require further investigation in the future	None identified at this point. May require further investigation in the future	N - Windows Mobile is no longer supported. There should be some consideration of the new Windows Phone OS in the future after its become more established in the market.

APPENDIX D:

Mobile Smart Phone Devices

Appendix D

Mobile Smartphone Devices

Criteria	Apple iPhone 4	Motorola Droid X	HTC EVO 4G	RIM Blackberry Torch 9800
Device keyboard. Physical or touch screen. Usability for capturing expense information that may need to be manually entered.	Touch Screen	Touch Screen	Touch Screen	Physical Keyboard and Touch Screen Keyboard
Image Capture. Ability for device to capture images of purchases that may serve as reminders for participant, of items purchased throughout the day. Images captured may also include receipts, or barcodes for alternate expense data capture approaches. Ease of use information provided as available.	Camera Present (rear facing and front facing)	Camera Present (single)	Camera Present (rear facing and front facing)	Camera Present (single)
Audio Capture. Ability for device to capture audio or dictation. Recordings of purchases throughout the day may serve as a quick approach for capturing purchase information throughout the day. Participant may review recordings at a later point to serve as reminder while populating CES forms.	Audio Recording capable	Audio Recording capable	Audio Recording capable	Audio Recording capable
Text and Email capable. Ability for device to easily send emails and text messages. Messages to an email address may serve as an approach to log purchases. Additionally, ability for multimedia messaging (MMS) provides the ability to send images or audio as attachments providing supporting material to reminder messages. Comments to include additional relevant information as available.	TEXT and Email Capable	Text and Email capable	TEXT and Email Capable	TEXT and Email Capable
Device weight. Device Size and weight may be a factor in the likelihood participants carry the device with them at all times. Weight of device to be provided where available.	4.8 oz	5.96 oz	6 oz	5.68 oz
Device Form Factor. General device form factors to be described as suitable for carry and ease of use throughout the day. (HxWxD)	Suitable 4.5 x 2.31 x 0.37 inches	Suitable 4.56 x 2.36 x .54 inches	Suitable 4.8 x 2.6 x 0.5 inches	Suitable (closed) 4.37 x 2.44 x 0.57in (open) 5.83 x 2.44 x 0.57in
Device Operating System. Specify the operating system of the mobile device.	iOS 4	Android 2.1 with Motoblur 2	Android 2.1 with HTC Sense	RIM BlackBerry 6 OS

Appendix D (cont.)

Mobile Smartphone Devices

Criteria	Apple iPhone 4	Motorola Droid X	HTC EVO 4G	RIM Blackberry Torch 9800
Device CPU. Specify the CPU options available for the device.	Apple A4(Max @ 1 GHz for iPad not confirmed for iPhone 4)	TI OMAP 3630 @ 1 GHz	Qualcomm 8650 Snapdragon @ 1GHz	Marvell PXA940 running 624 MHz
Memory. Specify memory options available for the device.	512 MB RAM	512 MB RAM	1GB ROM / 512 RAM	512 MB RAM
Storage. Specify storage options available for the device.	16 GB / 32 GB Internal	8GB	Micro SD Card (see below)	4GB integrated memory
MicroSD Card; Specify external memory options available for the device.	None	16 GB included (up to 32 GB)	8 GB included (up to 32 GB)	4 GB
Multitasking. Information to be provided regarding the devices ability to multitask – allowing user to leave one application, invoke another (e.g. image capture) and return to the original application as though uninterrupted.	Yes (iOS 4)	Yes (Android OS)	Yes (Android OS)	Yes
Battery Life. Ability to rely on the device for purposes of capturing data for CES will require that devices have sufficient battery power in support of this purpose. Specifications of battery power expectancy without recharge will be provided as available.	Talk time: Up to 7 hours on 3G Up to 14 hours on 2G Standby time: Up to 300 hours Internet use: Up to 6 hours on 3G Up to 10 hours on Wi-Fi Video playback: Up to 10 hours Audio playback: Up to 40 hours	Approximately up to 8 hours usage/talk time and up to 220 hours standby time	No official record published- up to 6 hours of talk time in independent tests.	18 days (GSM) or 14 days (UMTS) standby; 5.5 hours (GSM) or 5.8 hours (UMTS) talk
Carrier Availability. Identification of which mobile network operators carry the device.	ATT	Verizon	Sprint	ATT

Appendix D (cont.)

Mobile Smartphone Devices

Criteria	Apple iPhone 4	Motorola Droid X	HTC EVO 4G	RIM Blackberry Torch 9800
General Device Price. Information to be provided with regards to cost of device as well as usage plans that may be device specific. This information may be insightful regarding participant demographics. Information to be provided as available.	$199 for 16 GB $299 for 32 GB with ATT 2 year contract	$199.99 with 2 year contract and rebate	$199 with 2 year contract and rebate	$99 with 2 year contract and rebate
Website:	http://www.apple.com/iphone/	http://www.motorola.com/Consumers/US-EN/Consumer-Product-and-Services/Mobile-Phones/Motorola-DROID-X-US-EN	http://www.htc.com/us/products/evo-sprint	http://us.blackberry.com/smartphones/blackberrytorch/
WI-FI Capable. Is Device Wi-Fi capable	802.11 b/g/n	802.11 b/g	802.11 b/g	802.11 b/g/n
GPS Capable. Is device GPS capable	Yes	Yes	Yes	Yes

APPENDIX E:

Mobile Applications for Expense Data Collection

Appendix E

Mobile Applications for Expense Data Collection

Criteria	Shoeboxed mobile	Budgetdroid (Professional)	Mybudget	IXpenseit	EXGIS	Certify	ProOnGo
Device Agnostic. Determination if application is available on numerous devices and if so which.	N (Mobile app currently only for iPhone)	N (Intended for Android Devices)	N (Intended for iPhone) Android version "coming soon"	N (Intended for iPhone)	N (Intended for Blackberry)	Y - Blackberry, Windows Mobile, iPhone, Android	Y- BlackBerry, iPhone, Android, Windows Mobile)
Expense Entry. Is the entry of expense information performed manually or automated (e.g. receipt image scan)	Y	Y - Manual	Y - Manual	Y - Manual	Y - Manual	Y	Y
Image Capture. Does the application allow for image capture of receipt?	Y	N	N	Y	N	Y	Y
OCR Capable. Does the application perform (or attempt to perform) OCR on the image and determine expense amounts?	Y	N	N	N	N	Y	Y
Line Item purchase information. Does the application capture line item information or aggregated receipt information?	N - Tracks to the total of the receipt	Y - tracks to the level of detail entered by the user	Y - tracks to the level of detail entered by the user	Y- allows user to capture expense at level of detail they enter	Y- allows you to capture expense at level of detail they enter	N - Tracks to the total of the receipt	N - Tracks to the total of the receipt
Capture of Payment Method. Does the application capture payment method?	N	Y - uses accounts for payment types	Y	Y	Y	Unknown	N
Diary fields captured. Are all the fields in the diary able to be captured? (Information provided as available)	N - doesn't itemize at line items	N - However a notes field can potentially be used to capture additional diary field information	N - However a notes field can potentially be used to capture additional diary field information	Unclear - allows user to create subcategories as well as notes for each purchase. These fields could potentially be used to capture diary information. Also captures vendor item was purchased at	N - However a Description field can potentially be used to capture additional diary field information	N - However a Reason field can potentially be used to capture additional diary field information	N- However allows users to create additional fields to capture as part of expense
Configuration Capability. If all fields are not able to be captured – is there an ability to add additional fields as needed? (Data will be provided as available)	Y	Y- but very limited - Allows for creation of new categories	Y- but very limited - Allows for creation of new categories	Y	Y- but very limited - Allows for creation of new "Expense Types"	Y- but very limited - Allows for creation of new categories	N- However allows users to create additional fields to capture as part of expense
Expense Categorization. Does the application capture expense categories, can this be performed automatically or is it manually entered?	Yes - determines Category Automatically based on Vendor name	Y - manually	Y	Y - 2 levels - Category and sub category	Y - referred to as "Expense Types"	Y	Y
Additional Expense categories. Does the application allow for creation of new categories?	Yes	Y	Y	Y	Y- User can create new Expense Types	Y	Y

Mobile Applications for Expense Data Collection

Criteria	Shoeboxed mobile	Budgetdroid (Professional)	Mybudget	IXpenseit	EXGIS	Certify	ProOnGo
Data Export. Does the application allow data to be exported and if so, how and in what formats?	Y	Y	Y	Y - individual expenses or reports can be emailed	Y - allows for export to Excel	Y - Integrates with Certify Desktop Expense report Application - Exports can be performed from Desktop	Y- Exports to Excel as well as other formats
Web Portal data view and edit. Does the application provide a mechanism to view collected data online and validate/ modify as necessary?	Y	N	N	N	Y - Exgis offers an optional Internet Edition	Y - Certify Desktop Application	Y- with subscription
Source Code or Library availability. Is there general availability of source code or integration for product modification. Information provided where generally available.	Y - API	unknown	N	unknown	unknown	Unknown	Unknown
Integration with other expense management tools. Does the application have the ability to integrate with desktop or web based expense management applications?	Y	N	N	N	N	Y - Certify offers a scanning receipt option (they sell a scanner for $139) and can be integrated with their on Demand service. This may be an option for consideration.	Can be integrated with Quickbooks
Multi Language Support. Does product support multiple languages. If so, ones supported provided as comments.	Unknown	Unknown	English and German	Unknown	Unknown	Unknown	Unknown
Cost of Product. General cost of product.	Several versions exist Business $50/mo includes 500 scans/mo Classic $30/mo includes 150 scans / mo Light $10/mo includes 250 scans/mo Annual plans include additional discounts	Personal version Free Professional version last seen advertised at .99	0.99	$4.99	$4.99	Mobile app for download is free but the service that is integrated with their expense system is approximately $10/mo per user (price per user reduces as number of users increase)	Mobile application is free for download. Three subscription packages are available for Online Web access -.99/month, 2.99/month and 4.99/month
Website Product Website	http://www.shoeboxed.com/mobile-receipts-business-cards/	http://www.jeremygottwig.com/android/pbd.php	http://www.roqapps.com/iPhone/mybudget/mybudget.html	http://itunes.apple.com/app/ixpenseit-expense-income-cashflow/id284947174?mt=8	http://www.exgis.com/product_expensetracker.aspx	http://www.certify.com/	www.proongo.com
Notes: Additional relevant information or notes		While Budget Droid can be used to track expenses it is more intended to be used for managing to a budget. The user determines a budget amount for each category and as they spend they are reminded as to how much they have spent in that categories and how much budget remains. Should a tool of this sort be used it may influence and possibly reduce the amount a participant would have otherwise spent in that category.	While Mybudget can be used to track expenses it is more intended to be used for managing to a budget. The user determines a budget amount for each category and as they spend they are reminded as to how much they have spent in that categories and how much budget remains. Should a tool of this sort be used it may influence and possibly reduce the amount a participant would have otherwise spent in that category.	Similar to BudgetDroid and Mybudget, this tool provides the ability to capture expenses and manage to a budget, however the budget feature can be turned off so that expenses are not tracked against a predetermined budget allocation.		Certify is used to for employees to capture, track and receive approval for reimbursement of business expenses. Receipts are imaged on a mobile device and emailed from the mobile device and can also be captured via a scanner. The server performs OCR to determine the expense amount and allows the employee to modify information regarding the expense online and then submit to management for approval.	

APPENDIX F:

Barcoding Software for Mobile Devices

Appendix F

Barcoding Software for Mobile Devices

Criteria	RedLaser	Shop Savvy	TheFind	Google Shopper
Ability to operate on several device types. Is the application able to work on the devices included in the market scan? If so, specify which ones.	Y - iPhone (Android announced on Dec 8, 2010)	Y - iPhone and Android devices	Android and iPhone	Android
Scan history. Does the application store a history with time and date stamp of items barcoded?	Y - Retains a list of scanned products	Y	N	Y
Email. Does the application allow scanned information to be emailed (e.g. to be used as a reminder of purchase)? Yes, No, Comments:	Unknown - Feature list indicates ability to email scanned items. Not clear from attempts to use.	Allows for lists to be shared through Dropbox and several other social network (e.g. Facebook, Twitter)	Allows for finds to be shared through social network applications (e.g. Facebook,)	Allows for links to finds to be shared through Gmail and social network applications (e.g. Facebook,Twitter etc..)
Ease of use. Does the application allow for barcodes to be scanned easily and quickly? (Information provided as available from research)	Y - allows for quick scans of bar codes. The multiple feature allows users to take multiple bar	Y - scans fairly easily	Y (for its intended purpose)	Y (for its intended purpose)
Capture of additional information. Does the application allow for additional information to be stored with the barcoded product information (e.g. actual product cost) ?	N	Y- items scanned can be edited and additional attributes regarding the product can be added.	N - no obvious notes or other fields	N
Configuration. Does application provide an ability to be configured or modified for special purpose use:	N	Y- items scanned can be edited and additional attributes regarding the product can be added.	N	N

Appendix F (cont.)

Criteria	RedLaser	Shop Savvy	TheFind	Google Shopper
Barcoding Software for Mobile Devices				
SDK availability. Any SDK or Library available?	Yes - SDK available for integration of barcoding into other developer applications	Yes - SDK available for integration of barcoding into other developer applications	N	Unknown
Price. What is the cost of the application? Specify:	Free	Free	Free	Free
WebSite: Product Website	www.redlaser.com	http://shopsavvy.mobi/	http://www.thefind.com/	http://www.google.com/mobile/shopper/
Notes			Very specific purpose, not configurable. Intended to quickly find best deals - scan item, uses location to display best deals on item. No history etc available. Uses RedLaser technology for scanning.	Very similar to TheFind. Very specific purpose not configurable. Intended to quickly find best deals - scan item, uses location to display best deals on item.

APPENDIX G:

Scanners and Relevant Optical Character Recognition (OCR) Capabilities

Appendix G

Scanners and Relevant Optical Character Recognition (OCR) Capabilities:

Criteria	Xerox XTravel Scanner	Brother (formerly Pentax) DSmobile 600	NeatReceipts Mobile Scanner and Digital Filing System	Fujitsu ScanSnap S300 Mobile scanner
Ability to scan multi size paper. Receipts come in all sizes, ability to scan various sizes could serve important.	Y	Y	Y	Y
Auto multi page scanning. Ease of use could play a role in participant utilization. Ability to automatically capture multiple pages could play a role in a participant's decision to scan multi page receipts.	N- Single Pages at a time	N- Single Pages at a time	N- Single Pages at a time (For Mobile Scanner)	Y- Up to 10 pages
Optical Resolution of scanner. Does device have sufficient dots or pixels per inch (DPI/PPI) resolution for receipt scanning. (300 dpi typically required for OCR)	Y - 600 dpi	Y - 600 dpi	Y - 600 dpi	Y - 600 dpi
OCR supporting software included. Does scanner package include OCR software for character recognition. If yes, type is described in comments field.	Y - Includes Nuance PaperPort and Omnipage Pro	Y - includes PageManager 7.0 , DSmobileSCAN ,	Y - Includes NeatWorks Software	Y - Includes ScanSnap Manager V4.2, ScanSnap Organizer V3.2, CardMinder™ V3.2
Export to other formats – (e.g. Microsoft Excel). Does the scanner provide software for data to be exported to Excel or other potential software products for expense management.	Y- A wide range of image formats can also be converted into PDF – including TIFF, MAX, JPG, BMP and GIF.	Creates PDF text searchable documents. Other formats Unknown	Y - Images can be saved in JPEG, PDF and other popular formats Data can be sent to .XLS (Microsoft® Excel®), .RTF (Word), Outlook, .OFX, and .QIF (Quicken®), .TXF (TurboTax®), .IIF (QuickBooks®), .CSV, HTML, and PLAXO	Creates PDF text searchable documents. Other formats Unknown
Standard Drivers. Does scanner utilize standard drivers allowing for the potential to utilize additional software products deemed by the study?	Y - Visioneer OneTouch, TWAIN and WIA	Y - TWAIN & WIA	N - Scanners can only operate with Neat Software	N - (uses ScanSnap specific driver - TWAIN not supported)

Appendix G (cont.)

Scanners and Relevant Optical Character Recognition (OCR) Capabilities:

Criteria	Xerox XTravel Scanner	Brother (formerly Pentax) DSmobile 600	NeatReceipts Mobile Scanner and Digital Filing System	Fujitsu ScanSnap S300 Mobile scanner
Intended for expense management. Does scanner provide specific software or other capabilities intended for expense and receipt management? Yes, No, Comments:	N - Intended for image capture. Specialized software may be necessary to create expense reports	N - Intended for image capture. Specialized software may be necessary to create expense reports	Y	N - Intended for image capture. Specialized software may be necessary to create expense reports
Aggregated or line item level expense management. If software is intended for expense management, does it capture and convert individual line item expenses or receipt totals? Yes, No, Comments:	NA	NA	Captures Aggregated / Total receipt amount - no line item management	NA
Automatic or manual categorization of expense. If software is intended for expense management, does it automatically categorize the expense or is this performed manually?	NA	NA	Automatic	NA
Creation of new categories. If software is intended for expense management, does it allow for creation of new categories?	NA	NA	Y	NA
Accuracy. If software is intended for expense management, information will be provided as readily available through web searches on its accuracy performing this task.	Omni Page Pro (17) rated high for OCR accuracy	Unknown	Mixed reviews - see customer comments at link below	Y - Online review indicate that between 70 to 80 percent of the card scans produced accurate results
Ability to view, validate, and modify. Does the software provide an ability to view, validate and modify scanned information?	Y - Through OmniPage Pro	Unknown	Y - NeatWorks allows fields to be edited after scanned	Unknown

Appendix G (cont.)

Scanners and Relevant Optical Character Recognition (OCR) Capabilities:				
Criteria	**Xerox XTravel Scanner**	**Brother (formerly Pentax) DSmobile 600**	**NeatReceipts Mobile Scanner and Digital Filing System**	**Fujitsu ScanSnap S300 Mobile scanner**
Price. General Product Purchase price to be provided.	$120-$200	$110-$155	$199	$206-$300
Product Website.	http://www.xeroxscanners.com/en/us/products/ts100/ http://www.xeroxscanners.com/downloads/manuals/TS100/TS100_datasheet.US.pdf	http://www.brother-usa.com/Scanners/modeldetail.aspx?PRODUCTID=DS600&tab=spec http://www.newsoftinc.com/products/product-main.asp?productid=NAI0020&productmenus=159&submenus=520	http://store.neatco.com/index/page/product/product_id/26/product_name/NeatReceipts	http://www.fujitsu.com/us/services/computing/peripherals/scanners/scansnap/s300.html
Customer/user comments.			http://www.obsessable.com/feature/obsessable-neatdesk-review/	http://thefutureofthings.com/articles/1014/fujitsu-s300-scanner-review.html

APPENDIX H:

Selected Laptops (for use by the CAPI Interviewers)

Appendix H

Selected Laptops (for use by the CAPI Interviewers)

Criteria:	Toshiba – Tecra A11 (S3540)	HP ProBook 4520s	Fujitsu - LIFEBOOK E780	Dell – Latitude E5510
Device size and dimensions. Specifications of device size and dimensions to be provided.	(W x D x H): 14.7" x 9.86" x 1.31"/1.48"	(W x D x H): 14.64" x 9.83" x 1.09"	(W x D x H): 14.64" x 10" x 1.42"	(W x D x H): 14.61`" x 9.84" x 1.33"
Device Weight. Specifications of device weight to be provided.	Starting at 5.63 lbs., depending upon configuration	Starting at 5.26 lb depending upon configuration	6.1 lb - depends upon configuration	Starting weight 5.64 lbs
CPU and Memory. Specifications of CPU and memory to be provided.	Intel Core i7-620M processor 2.66 GHz (3.33 GHz with Turbo Boost Technology), 4MB Cache Mobile Intel QM57 Express Chipset.	CPU Options Include: Intel® Core™ i7-620M Processor (2.66 GHz, 4 MB L3 cache) Intel® Core™ i5-520M Processor (2.40 GHz, 3 MB L3 cache) Intel® Core™ i5-430M Processor (2.26 GHz, 3 MB L3 cache) Intel® Core™ i5-450M Processor (2.40 GHz, 3 MB L3 cache) Intel® Core™ i3-370M Processor (2.40 GHz, 3 MB L3 cache) Intel® Core™ i3-350M Processor (2.26 GHz, 3 MB L3 cache) Intel® Core™ i3-330M Processor (2.13 GHz, 3 MB L3 cache) Intel® Celeron® Processor P4500 (1.86 GHz, 2 MB L3 cache) Memory Options include: 8 GB 1333 MHz DDR3 SDRAM 8 GB 1066 MHz DDR3 SDRAM	Intel® Core™ i5 or i7 processor, Intel® vPro™ technology Intel® Core™ i7-640M processor (2.80 GHz, 4 MB) Intel® Core™ i7-620M processor (2.66 GHz, 4 MB) Intel® Core™ i5-560M processor (2.66 GHz, 3 MB) Intel® Core™ i5-540M processor (2.53 GHz, 3 MB) Intel® Core™ i5-520M processor (2.4 GHz, 3 MB) 2 GB (1 module(s) 2 GB) DDR3, 1066 MHz, PC3-8500, SO DIMM 4 GB (1 module(s) 4 GB) DDR3, 1333 MHz, PC3-10600, SO DIMM	Intel® CoreTM i7 (640M) Intel® CoreTM i5 (580M, 560M, 460M) Intel® CoreTM i3 (370M) Up to 4GB4 DDR3 SDRAM at 1333Mhz - 2 DIMMS
Build Quality. Insights on build quality and durability of devices to be provided where known.	The notebook opens and closes smoothly, though the hinges offer enough resistance that the notebook often lifted slightly from the desk if you attempt to open it with one hand. Above the display, you'll find the system's webcam. Tecra A11-S3540 has a textured finish in charcoal black. Considering this notebook primarily targets business users, we think this finish was a wise choice on Toshiba's part—Business users who want an understated design will definitely appreciate the finish on the A11. In addition, this finish doesn't tend to attract fingerprints like other high gloss finishes we've seen on some of Toshiba's Satellite models. (Hot Hardware review)	Build quality is very good and a step up from the older model. The brushed metal lid gives the 4520s some much needed strength and screen protection that the plastic lid on the previous model lacked. The palm rest and speaker grill also gained some rigidity and now offer very little flex under strong pressure. The chassis as a whole feels very well built but still a step below full business notebooks like the EliteBook or ThinkPad series. The keyboard tray has some minor flex under pressure which wouldn't be a problem on the more expensive models. (Notebook Review)	Like most business-focused laptops, the E780 isn't the prettiest machine to look at. Big and boxy, it's finished in a combination of silver and matte black. It's pretty heavy, at 2.75kg, and quite thick, too, measuring 36mm deep, so it's more likely to appeal to desk-bound workers rather than road warriors. Its chunky dimensions mean it feels remarkably well built -- even when you apply pressure to the chassis and lid, there's very little give.	Despite its more modest price, the E5510 uses magnesium alloy in its frame and hinges, whereas other SMB laptops like the Dell 3300 and Lenovo Edge 15 primarily use plastic. It's as tough as enterprise laptops like the Lenovo ThinkPad T410 ($1,484 direct,) and HP EliteBook 8440w ($1,650 direct,), which are designed to absorb a great deal of shock, survive drops, and bear the brunt of an everyday commute.
Video Image Quality. Image quality insights to be provided.	High-resolution widescreen 15.6-inch display. Some models also offer NVIDIA NVS 2100M graphics.	15.6" diagonal LED-backlit HD anti-glare Graphics Capability include: Integrated Intel HD Graphics ATI Mobility Radeon HD 530v with 512 MB dedicated video memory.	15.6" diagonal supports HD or HD+ display with LED backlight Several Display Options available: 39.6 cm (15.6-inch), LED backlight, (HD+), anti-glare display, magnesium, 1600 x 900 pixel, 300:1, 220 cd/m² 39.6 cm (15.6-inch), LED backlight, (HD), anti-glare display, magnesium, 1366 x 768 pixel, 400:1, 220 cd/m² 39.6 cm (15.6-inch), LED backlight, (HD), anti-glare display, compound, 1366 x 768 pixel, 400:1, 220 cd/m² 2 Graghics Versions available LIFEBOOK E780 with High Performance NVIDIA® graphics LIFEBOOK E780 Intel® graphics	Two Video Display Options available: 15.6" HD+ Wide View Anti-Glare LED Display (1600 x 900) 15.6" HD Anti-Glare LED Display (1366 x 768) Intel HD Graphics with dynamic frequency

Appendix H (cont.)

Selected Laptops (for use by the CAPI Interviewers)

Criteria:	Toshiba – Tecra A11 (S3540)	HP ProBook 4520s	Fujitsu - LIFEBOOK E780	Dell – Latitude E5510
Keyboard and touch pad. Keyboard and touch pad usability information to be provided.	The keyboard is nice and roomy with a pretty standard layout and matte keys that won't attract fingerprints. Anyone who regularly uses his laptop for data entry will also appreciate the roomy 10-key numeric keypad. The TouchPad has a smooth finish with a defined edge and two silver buttons beneath. Between these mouse buttons, you'll find the A11's fingerprint sensor.	Full-sized spill-resistant keyboard with drain and separate numeric keypad. ClickPad includes gestures support; Two fingers scroll, zoom, pinch and pivot rotate. The full-size keyboard on the 4520s shares the same design as the one found on the 4510s and provides fantastic spacing between keys for typing as well as a dedicated number pad (a major plus for businesses that use their computers for number crunching or data entry). The individual key presses are quiet without loud clicking sounds as you type. The depth of each key press is excellent, though some people may dislike the flat, chicklet-style keys. Overall the keyboard layout is extremely nice for a 15-inch laptop. Overall the touchpad was very sensitive and easy to use (not including the aforementioned problems). Tracking speed was excellent and we had no problems with input lag. Multitouch gestures were quickly recognized and worked smoothly. The touchpad refresh rate was very high, allowing us to draw fast circles with very little trailing effect on the cursor. If the touchpad didn't have the problems associated with the left and right buttons with fingers resting on the surface, it would have been one of the nicer models we have used on a notebook.	The traditional Qwerty keyboard sits centrally between the two speakers and uses standard tapered keys. It feels very solid and there's almost zero flex, but the keys on our model felt a little sticky and had a slower action than what we're used to. It's possible the keys may free up over time with prolonged usage. The trackpad is relatively small by 15-inch laptop standards and has two sets of buttons at the top and bottom. The top set is designed to be used with the point stick that comes with another variation of this laptop. Although a point stick wasn't included with our model, the buttons were still present and a tad annoying, as they were easily tapped accidentally when typing.	The Keyboard offers a clear layout and for all keys an agreeable size. Typing proves to be a bit jerky but after a certain accommodation period is found to be pleasant. A feasible bend of the keyboard unit wasn't noticed. The touchpad/trackpoint combination surface has good gliding qualities and above that two scroll areas. Especially both accompanying touchpad keys turned out as quite pleasant. These let themselves be pressed with an agreeable resistance and can be used with just one or even with both hands. Alternately, the mouse cursor can be controlled with the trackpoint. The shape of the trackpoint didn't really completely convince in the test, though. The smooth frame led to the finger sliding off of it. The fact that the trackpoint needs a certain amount of pressure to react didn't make it easier, either.
Battery Life. Information on battery life to be provided.	Battery Life Rating (measured by MobileMark Productivity 2007) Included 6 cell battery: 3 hours, 7 minutes	Options include: 9-cell (93 WHr): up to 10 hours (integrated) 9-cell (93 WHr): up to 8 hours (discrete) 6-cell (47 WHr): up to 5 hours (integrated) 6-cell (47 WHr): up to 4 hours (discrete)	Standard graphics - Runtime 1st battery up to up to 12 h - Runtime 1st and 2cnd battery up to 18 h With NVIDIA® graphics - Runtime 1st battery up to 5 h - Runtime 1st and 2cnd battery up to 8 h Battery life may vary depending on product model, configuration, applications, power management settings and features utilized	Dell E5510 includes a big 85WH (9-cell) battery - the Dell E5510 shined in MobileMark 2007—a battery test. It scored 7 hours 5 minutes,
Pros. General pros for each device to be provided.	User Findings: Appeared to run cooler, ease of port location, audio and video recording quality, touchpad, HDMI availability. Toshiba has included additional security features such as a fingerprint reader with the A11. Inclusion of EasyGuard Technology provides added protection from shocks and spills and enhanced data security.	User Findings: Fast, high build quality, weight, uncluttered design, speaker sound, wireless on/off key, battery life, anti-glare, HDMI.	Fast performance Impressive security features Excellent build quality Good battery life	Excellent keyboard and very good display. Custom configuration options for small businesses
Cons. General cons for each device to be provided.	Applications appeared to launch slightly slower, weight, speaker sound quality	Sound recording and webcam - seemed like poorer quality than some others, trackpad, fewer USB ports than some of the others	Disappointing screen Below-par keyboard and trackpad	No eSATA or digital video output. Pricey for what you get; no discrete graphics.
Price & Warranty. Standard pricing and warranty of devices as available to be provided.	A11-S3540 has an MSRP of $1,349 with a three-year limited warranty. Other models in the Tecra A11 series start at $879	Series begins at Starting at: $ 549.00. Cost increases with options. HP Services includes a one-year standard parts and labor warranty, pick-up or carry-in, and toll-free 7 x 24 hardware technical phone support (depending on model). On-site service and warranty upgrades are also available.	MSRP starting at $1,149. Cost increases with options. 1 year (Intel GFX) / 2 years (NVIDIA GFX) - depending on configuration	Dell Starting Price $579. Cost increases with options 2 year warranty
Website	http://us.toshiba.com/computers/laptops/tecra/A11	http://h10010.www1.hp.com/wwpc/us/en/sm/WF06a/321957-321957-64295-3929941-3955552-4145198.html	https://globalsp.ts.fujitsu.com/dmsp/docs/ds-lifebook-e780.pdf	http://www.dell.com/us/business/p/latitude-e5510/pd?~ck=anav
Reviews	http://hothardware.com/Reviews/Toshiba-Tecra-A11S3540-Review/	http://www.pcworld.com/reviews/product/527437/review/probook_4520s.html	http://reviews.cnet.co.uk/laptops/fujitsu-lifebook-e780-review-50000908/	http://www.pcworld.com/reviews/product/567632/review/latitude_e5510.html http://www.pcmag.com/article2/0,2817,2367901,00.asp

Appendix H: Laptops H-2

APPENDIX I:

Selected Tablet/Slate Devices

Appendix I

Selected Tablet/Slate Devices

Criteria	Apple iPad	HP Slate	Dell Streak (AKA Mini 5)	Lenovo U1
Operating System. Latest operating system available for the device.	iOS 4	Windows 7	Android	Dual Mode: Windows 7 Tablet Mode: Lenovo's Skylight Linux-based OS (OS may be changing)
Processor. Information regarding device processor.	1GHz Apple A4	Intel® Atom™ Processor Z540 (1.86 GHz, 512 KB L2 cache, 533 MHz FSB)	Qualcomm 1 GHz Snapdragon	Dual Mode: Intel CULV (Dual Core) processor Tablet Mode: 1GHz Snapdragon
Screen/Video specifications. Information regarding screen size and resolution .	9.7 inch 4:3 IPS LCD (1024X768)	8.9" capacitive multi-touch screen supporting 1024×600 pixel resolution with digitizer and pen support	5" LCD	11.6-inch HD LED touch screen
Storage. Information regarding device storage.	16,32,64 GB	Up to: 64 GB	16 GB storage, 512 MB ROM, 512 MB RAM	Unknown
Weight. Information regarding device weight to be included.	1.5 lbs	Starting at 1.5 lb	.48 lb	Laptop mode 3.8 lb Tablet Mode: 1.6 lb
Dimensions:	9.56 x 7.47 x .5 in	9.21 x 5.91 x 0.58 in	6.02 x 3.11 x .39 in	
Battery Life. Length of battery time prior to charge being necessary.	10 hours video, 140 hours audio, 1 month standby	up to 5+ hours	Stand-by Up to 400 h Talk time Up to 9 h 48 min	Tablet Mode: 5 hours of 3G Web browsing and 60 hours of 3G standby
Camera. Information regarding camera or other video capture options.	No	Integrated 3 MP camera (outward facing); Integrated VGA webcam (inward facing)	5 MP, 2592x1944 pixels, autofocus, dual-LED flash	1.3-Megapixel camera
Wireless Connectivity Options. Available wireless connectivity information.	Wi-Fi, 3G (HSPA/GSM-optional), Bluetooth	Integrated 802.11b/g/n + Bluetooth 3.0 + HS combo	Connectivity Wi-Fi (802.11b/g), Bluetooth 2.1+EDR, GPS with A-GPS, UMTS 2100 / 1900 / 850 MHz GSM, / EDGE 1900 / 1800 / 900 / 850 MHz HSDPA / HSUPA:HSDPA, 7.2 Mbps / HSUPA 5.76 Mbps, PDMI	Wi-Fi - others expected but unknown

Selected Tablet/Slate Devices

Criteria	Apple iPad	HP Slate	Dell Streak (AKA Mini 5)	Lenovo U1
GPS:	Assisted GPS	No	Assisted GPS	Unknown
I/O Options. Information regarding input and output connectivity options.	30-pin: Camera Only , USB add on	USB	Unknown	Unknown
Multitasking. Information regarding Device/OS ability to multitask.	Yes (New to iOS 4)	Yes	Yes	Yes in in laptop mode
Availability of Applications. Information regarding the availability of applications for the device.	Applications are purchased and downloaded through the Apple app store and iTunes	Runs Windows applications	Runs Android applications	Laptop mode runs Windows applications
Price. Pricing information.	$500-$830 Depending upon options	$799	Starts at $299 with ATT 2 year contract	Estimated to retail at $999.00
Updates. Information available regarding known updates and new versions	A new iPad is rumored to become available in 2011, will likely include a camera - currently not found on the existing iPad	Originally device was planned to use WebOS as the Operating system. Hp opted for Windows7 in order to target corporate customers with existing applications running on Windows. Device order Backlogged	Currently runs Android 1.6. 2.2 Android upgrade planned for end 2010 7 and 10 inch models are rumored	Availability of device has been delayed by Lenovo. Rumors indicate this may focus on utilizing Android OS in place of other OS. OS direction still unclear.
Website:	http://www.apple.com/ipad/	https://h30406.www3.hp.com/campaigns/2010/promo/HPSL/index.php?	http://content.dell.com/us/en/corp/d/videos~en/Documents~Dell%20Streak%20-%20The%20versatile%205-inch%20Android%20tablet.aspx.aspx	http://shop.lenovo.com/us/notebooks/ideapad/u1
Information source/links	http://store.apple.com/us/browse/home/shop_ipad/family/ipad http://en.wikipedia.org/wiki/IPad#cite_not	http://h10010.www1.hp.com/wwpc/us/en/sm/WF06a/321957-321957-64295-3841267-3955550-4332585.html http://en.wikipedia.org/wiki/HP_Slate_500	http://www.dell.com/us/p/mobile-streak/pd http://www.gsmarena.com/dell_streak-3353.php http://en.wikipedia.org/wiki/Dell_Streak	http://www.islates.us/?p=646 http://nexus404.com/Blog/2010/05/29/lenovo-kills-off-skylight-os-skylight-and-u1-hybrid-get-axed-lenovo-to-shift-away-from-skylight-os-and-focus-on-google-android/