SCANNING TECHNOLOGY CAN IMPROVE TIME-USE STUDIES

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Abstract

Public agencies, private businesses and researchers employ time-use studies to track how individuals actually spend their time. A recent study by the U.S. General Accounting Office (GAO) used a scanner technology to electronically record, transmit, and analyze time study data. This paper presents an overview of time study methodologies, and a discussion of GAO's time-use study's methodlogy. We found that employing the scanner technology reduced the burden associated with employee self-report of time use, while improving the reliability of the data. Some federal, state and local agencies either currently require time studies, or may require them in the future. We suggest that these agencies could use scanner technology to obtain faster, more reliable time study data from employees, which could improve program accountability and performance.

Introduction

In 1998, the Congress directed the U.S. General Accounting Office (GAO) to study the costs associated with providing services under the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) program (Pub. L. 105-336, Sec. 203). As part of this study, we conducted case studies of six WIC agencies. These case studies included a study of how the employees at the agencies allocated their work time among different activities. We used two self-report methods to gather this information. At five of the agencies employees recorded their time using a hand-held scanner and a set of bar codes. At the sixth agency, employees recorded their time on a preprinted timesheet. This paper discusses the advantages and disadvantages of self-reporting time use and the implications of using the bar code scanning method for data reliability.

Why Perform Time Use Studies?

If you were asked to recount in detail how you spent your time yesterday you would probably have difficulty doing so. You would probably have even more difficulty reporting how long you spent at each activity. For instance, you might think that an onerous task took longer than it actually did while a pleasant task required relatively little time to complete. Time-use studies are conducted to determine accurately how people spend their time. Time-use data can be used to:

- redesign processes to streamline the flow of work,
- identify staffing skills needed to provide services to a particular clientele,
- test and evaluate changes in service delivery procedures,
- customize staff training to support unique operations, or
- assess how a proposed reorganization or budget cut may affect procedures and staffing.

In addition to these reasons, we found that some public agencies employ time-use studies to account for how public moneys are spent. For example, some state and local agencies are required, as federal grant recipients, to document the distribution of personnel costs charged among multiple activities or cost objectives (OMB 1997, Attachment B, Subsection 11 (h)(4)). Agencies can meet this requirement by having their employees complete personnel activity reports, also known as timesheets or time-and-effort reports, on a continuous basis to account for all of the employees' time (OMB 1997, Attachment B, Subsection 11 (h)(5); Health and Human Services 1997, 3-13). Agencies can also use a substitute method for documenting the allocation of salaries and wages to federal awards (OMB 1997, Attachment B, Subsection 11 (h)(6)). Time-use studies are one of the substitute methods that can be used by state and local agencies receiving WIC funding (USDA 1999, 3-12).

How Are Time-Use Studies Performed?

The first time-use studies relied on direct observation. Frederick Taylor, an engineer at a Philadelphia steel plant, developed this methodology in the 1880s. Taylor wanted to define the standard time required to perform a task in order to improve employee productivity (Flynn, 1998). An adaptation of the Taylor methodology, referred to as the motion study, was developed by Frank and Lillain Gilbreth in the early 20th century to determine the simplest, least fatiguing way to perform a task (Ferguson 1997). Both of these methodologies rely on direct monitoring of individuals, as they perform various tasks, as well as the elapsed time for each task (Flynn 1998). Today, the monitoring may be performed using a video camera (Ferguson 1997). A major advantage of direct observation is that it can provide very accurate data, as well as descriptions of the processes and setting. Major disadvantages include its intrusiveness and expense (National Research Council 2000).

Another type of methodology relies on information reported by respondents, i.e., self-report, rather than direct observation. Participants may be asked to record, on customized timesheets, the time they spent on specific activities (Aikin, et al. 1993; Albinsson, et al, 1996; Hatfield, et al. 1985). Alternatively, participants can report their activities to a data collector, who then records the information (Stinson 1999). Self-report can be less intrusive and require less of the researchers' time than direct observation. However, this methodology also has its limitations. First, the accuracy of the data depends on the diligence, understanding, and honesty of the participant. Second, it can be difficult to accurately record activities when participants are performing multiple tasks at the same time. Third, data need to be entered into a computer before they can be analyzed.

GAO's Time-Use Study at WIC Agencies

Description of the Federal WIC Program

WIC is a USDA grant program that provides supplemental foods and nutrition services to lower-income pregnant, breastfeeding, and postpartum women, infants, and children up to age 5 who are at nutritional risk (General Accounting Office, 2000a, 3). Approximately $1.1 billion in WIC funds in fiscal year 1999 was used to provide grants to state WIC agencies for nutrition services

and administration of these services. The nutrition services are (1) participant services, i.e., certifying eligibility to participate in the program, issuing food benefits, and making referrals to other health or social service agencies; (2) nutrition education, i.e., providing individual or group education to improve participants' dietary habits and health status; and (3) breastfeeding promotion and support, i.e., educating women about the benefits of breastfeeding and providing the support necessary to enable them to breastfeed. Administration includes the functions necessary to support program operations, such as accounting and record-keeping (General Accounting Office, 2000b, 5).

WIC requires state and local grant recipients to account for salaries and wages allotted to WIC and non-WIC activities and to the type of service (participant services, nutrition education, breastfeeding promotion) and administration (USDA 1999, 3-1). To comply with the cost reporting requirements, most state and local WIC agencies use either continuous time-use reporting or periodic time-use studies. According to unpublished GAO data from 1416 local WIC agencies (General Accounting Office, 1999b), about the same percentage of respondents (40%) used continuous time-use reporting as used periodic time studies (44%) during federal fiscal year 1998.

Task Analysis of WIC Activities and Creation of Coding System

A critical first step in conducting a time-use study is the identification and categorization of different work processes and associated activities. This procedure, sometimes referred to as task analysis, requires the identification of major work processes and then the delineation of major tasks or activities involved in each process. For instance, the budgeting process might include such activities as the review of past budgets, the review of past expenditures, and the approval of the proposed budget. Once the task analysis is complete, the processes and associated activities must be verified with the individuals who will participate in the study. This ensures that most, if not all, of the possible activities are defined and that each activity has been associated with the correct process.

To conduct the task analysis for this study, we reviewed USDA documentation, recent WIC research, and examples of WIC time studies from several states. Processes were identified for each of the three types of WIC services and for administration. Individual activities were identified for each of the processes. Once these processes and activities were identified, they were reviewed by WIC administrators and employees. The final coding system used for this study included 4 service/administration categories (participant services, nutrition education, breastfeeding promotion, and administration) and 30 activity categories. Each activity category consisted of a process and its associated activities. Table 1 provides examples from the coding system (General Accounting Office, 2000b, 29). The same coding system was used for all six of the agencies included in our study.

Table 1: Examples of Categories and Associated Activities Used for Time-Use Studies at Six WIC Agencies

Service or Administration Category	Activity Categories	
	Process	**Associated Activities**
Participant Services	Determining participants' eligibility[a]	Determining eligibility (income, category, residence); obtaining necessary documentation and copying it; completing forms or computer screens; obtaining physical measurements and blood work to determine eligibility; obtaining and recording immunization data; handling complaints.
Participant Services	Assessing participants' nutritional risk[a]	Obtaining physical measurements, such as height and weight, and blood work to assess risk or intervention level; completing assessments and tests; determining appropriate risk factors; assessing immunization status; completing forms or computer screens; discussing nutrition and breastfeeding; developing care plans; developing food packages; reviewing charts; recording progress.
Nutrition Education	Providing one-on-one nutrition education or counseling[a]	Providing one-on-one counseling/education sessions outside of the certification/recertification process; explaining WIC foods and food preparation; following up, and documenting meetings. Includes phone calls and visits to, for example, the home or a hospital.
Breastfeeding promotion and support	Providing group breastfeeding instruction/ Counseling[a]	Providing group breastfeeding counseling/education
Administration	Personnel tasks	Completing timesheets; processing payroll, hiring and terminating staff; orientation of new personnel; supervising staff; providing non-WIC staff training.

[a]Activity involved direct contact with participant, or potential participants, either in person or by telephone.

Hand-Held Bar Code Scanners

Given our time and resource constraints, we decided that using direct observation to collect time-use data was not a viable approach. We conducted a literature search of studies in the public health field to identify alternative time-use self-report methods. One article described a time-use study in which hospital employees used hand-held bar code scanners to record the time spent on different activities (Stevens 1994). Using this technology appeared to reduce the burden associated with self-report methods, while improving the reliability of the data. We decided to use this technology in our study of time-use at WIC agencies.

The system we used was developed by Work Management Institute, LTD. We contracted with them to provide equipment and technical support. Their system enables study participants to record time spent on their daily activities by swiping a small bar code scanner across bar codes assigned to predetermined activity categories (see Figure 1). The scanner records both the activity and the elapsed time spent on each activity. At the end of each workday, scanners are

returned to a recharging device. This device also has a modem connection, enabling the contractor to download each employee's daily data. (A detailed description of the system is provided at the end of this paper.)

Figure 1: Bar code scanner and sheet used in GAO time-use study

We used the hand-held scanner system to collect time-use data at five of the six WIC agencies we studied. Before data collection began, WIC employees received training on the purpose of the study, the WIC activity categories, the use of the scanner and bar code sheets, and reporting procedures. The employees were then given two days to practice the scanning procedures. The study period for each agency lasted approximately one month (20 consecutive workdays). During the data collection period, WIC employees were asked to use the hand-held scanner and code sheets as they performed various activities at their desks, in other office spaces, or on work-related travel.

After the first day of practice, each participant received a printed report of the previous day's recorded data. (A sample of a daily report is in Figure 2.) The contractor then met individually with each employee. Together, they reviewed the report from the previous day's work, and discussed any difficulties the employee had in understanding procedures or using the bar code scanner. The contractor also explained the procedures for the employee to follow in correcting any errors found in a daily report. These procedures were repeated, as needed, during the second day of practice. The employees began their 20 workdays of recording on the first Monday that followed the practice days.

Figure 2. Sample of part of a daily report from scanned WIC time-use study data

Task	Description	Start	Finish	Minutes	
U01	CLERICAL	7:42	7:42	0	
U01	CLERICAL	7:42	8:40	58	<Is this time correct?
U02	TRAVEL	8:40	9:13	33	Problem w/ laptop
U01	CLERICAL	9:13	9:17	4	Computer.
CD4	CERT-NUTR ASSES RK	9:17	9:49	32	
ZZ2	NON-WIC/LUNCH/BRKS	9:49	9:54	5	
CD4	CERT-NUTR ASSES RK	9:54	9:58	4	
CD7	CERT-VOUCHERS	9:58	10:00	2	
CD2	CERT-SCHEDULING	10:00	10:02	2	
ND1	NUTR-INDIVID COUNS	10:02	10:14	12	
CD5	CERT-REFRRL&FLLWUP	10:14	10:39	25	
CD7	CERT-VOUCHERS	10:39	10:41	2	
CD2	CERT-SCHEDULING	10:41	10:44	3	
CD4	CERT-NUTR ASSES RK	10:44	10:48	4	
CD2	CERT-SCHEDULING	10:48	10:54	6	
ND1	NUTR-INDIVID COUNS	10:54	11:02	8	
NI1	NUTR-MATERIALS/ACT	11:02	11:25	23	
CD7	CERT-VOUCHERS	11:25	11:29	4	
NI1	NUTR-MATERIALS/ACT	11:29	11:33	4	
CD7	CERT-VOUCHERS	11:33	11:34	1	
CD2	CERT-SCHEDULING	11:34	11:36	2	
ND1	NUTR-INDIVID COUNS	11:36	11:38	2	
BD1	BRST-INDIVID COUNS	11:38	11:43	5	
U01	CLERICAL	11:43	11:49	6	
ZZ2	NON-WIC/LUNCH/BRKS	11:49	12:47	58	
CD3	CERT-ELIGIBILITY	12:47	13:05	18	
CD7	CERT-VOUCHERS	13:05	13:36	31	
CD4	CERT-NUTR ASSES RK	13:36	13:40	4	
ND1	NUTR-INDIVID COUNS	13:40	13:44	4	
BD1	BRST-INDIVID COUNS	13:44	13:52	8	
CD4	CERT-NUTR ASSES RK	13:52	13:55	3	
CD7	CERT-VOUCHERS	13:55	14:06	11	
CD4	CERT-NUTR ASSES RK	14:06	14:06	0	

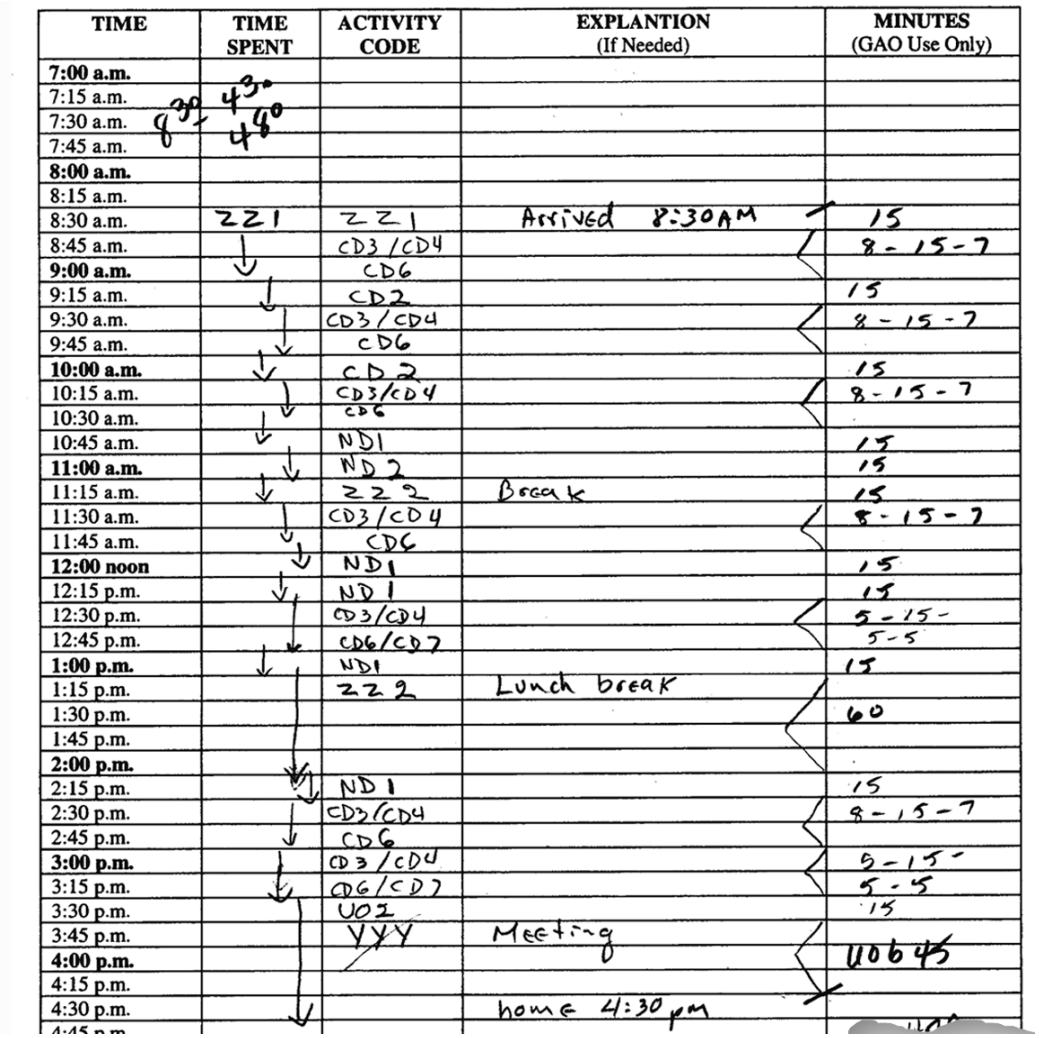
During the study period, the contractor downloaded the employees' data every evening. Each employee's data were reviewed to ensure that the data met technical requirements, such as having one sign-in and one sign-out for that day. The contractor then analyzed the recorded time for each activity, for every employee. Beginning with the practice period, the mean and standard deviation for time spent on each activity were calculated. During the data collection period, each day's data were appended to this data set and the total data set was used to re-calculate the mean and standard deviation for each activity. Each employee's data were compared with these statistics. The daily report was faxed to each employee by noon the following day. If any employee's recorded time for any work activity was more than two standard deviations above or below the mean the contractor made a note (e.g., "Is this correct?") on the summary report. Employees provided the contractor with comments or corrections, and each employee's data file was corrected if necessary. For instance, as illustrated in Figure 2, the contractor made a note that the employee had problems with a laptap computer, and this accounted for the large amount of clerical time for that day.

GAO Time Study With Timesheets

One WIC agency we studied was considerably larger than the other agencies, with as many staff members as the other five agencies combined. Because of time and resource constraints, we did not use the hand-held scanners for this agency. Instead, we used booklets that included coding categories and a timesheet for recording activity codes and the amount of time spent in that activity. Staff at this agency used the same activity coding system as the other agencies and received on-site training from GAO staff that was similar to that provided to the agencies using the bar code scanners. A toll-free number was provided so that staff members could call GAO if they had questions about recording their times.

WIC staff recorded their times for one day each week over a 5-week period, for a total of five days of data collection. We assigned the days for time-use recording, so that staff recorded their times once on each day of the week. On any given day approximately one-fifth of the staff recorded their time use. If an employee could not record times on his or her assigned day, GAO assigned a substitute day. An example of a completed time sheet is illustrated in Figure 3.

Figure 3. Example of a completed timesheet from a WIC employee



TIME	TIME SPENT	ACTIVITY CODE	EXPLANTION (If Needed)	MINUTES (GAO Use Only)
7:00 a.m.				
7:15 a.m.				
7:30 a.m.				
7:45 a.m.				
8:00 a.m.				
8:15 a.m.				
8:30 a.m.	ZZ1	ZZ1	Arrived 8:30AM	15
8:45 a.m.		CD3/CD4		8-15-7
9:00 a.m.		CD6		
9:15 a.m.		CD2		15
9:30 a.m.		CD3/CD4		8-15-7
9:45 a.m.		CD6		
10:00 a.m.		CD2		15
10:15 a.m.		CD3/CD4		8-15-7
10:30 a.m.		CD6		
10:45 a.m.		ND1		15
11:00 a.m.		ND2		15
11:15 a.m.		ZZ2	Break	15
11:30 a.m.		CD3/CD4		8-15-7
11:45 a.m.		CD6		
12:00 noon		ND1		15
12:15 p.m.		ND1		15
12:30 p.m.		CD3/CD4		5-15-
12:45 p.m.		CD6/CD7		5-5
1:00 p.m.		ND1		15
1:15 p.m.		ZZ2	Lunch break	
1:30 p.m.				60
1:45 p.m.				
2:00 p.m.				
2:15 p.m.		ND1		15
2:30 p.m.		CD3/CD4		8-15-7
2:45 p.m.		CD6		
3:00 p.m.		CD3/CD4		5-15-
3:15 p.m.		CD6/CD7		5-5
3:30 p.m.		UO1		15
3:45 p.m.		YYY	Meeting	
4:00 p.m.				10645
4:15 p.m.				
4:30 p.m.			home 4:30 pm	

Prior to data collection, each WIC employee was given five timesheet booklets and five mail courier envelopes for sending their timesheets to GAO as they completed them. GAO typically received the timesheets two days after the employee recorded the data. Upon receipt, the timesheets were logged in, then checked for completeness and to identify anomalies. GAO staff called the WIC employee if data were missing or if there was a question about the way times were recorded. The data were then coded onto data entry sheets that were reviewed by a second GAO staff member. Discrepancies or questions were resolved through consultation with the first staff member.

Feedback From Study Participants

To assess how study participants felt about using the bar code scanning method we surveyed WIC staff at the five agencies that used this methodology. Over 40 of the 50 staff members from the five WIC agencies who used the scanning method responded to the survey.

The survey results indicated that almost two-thirds of these respondents felt that the bar code scanning method compared favorably with other ways of recording time use. For instance, 60 percent of the respondents felt that bar code scanning was more accurate than other ways of recording their time. About the same percentage of respondents also felt that the scanning method was easier to do than other recording methods.

Though these respondents felt the bar code scanning method was better in some respects than other methods, they also indicated that there was room for improvement. Respondents were not always comfortable with the daily results. As indicated earlier, the study participants received and reviewed a daily report of their previous day's activities. Only 29 percent of the respondents felt the daily reports they received for review were always an accurate picture of how they spent their time.

The participants' perceptions of the accuracy of the daily reports may be attributed to several aspects of GAO's procedures. First, the fact that congressional investigators were studying their agency in order to obtain detailed information on personnel costs may have heightened the sensitivities of the WIC employees. Second, GAO's system for coding WIC activities, though an amalgam of existing WIC coding systems, was different from the coding systems the study participants ordinarily used for their agencies' time studies. Third, this was the first time the study participants had used the bar code scanners, followed these particular study procedures, and reviewed daily computer-generated reports of their activities. Finally, several participants indicated during the training period that they were uncomfortable with the limited ability to capture instances when they were performing two or more tasks at the same time, such as providing nutrition education while weighing a participant.

The perceived accuracy of the daily reports, as well as the efficiency in using the bar code scanners, would likely improve with more experience and training. In addition, the coding system and scanning procedures could be revised to better account for those occasions when WIC employees are performing multiple tasks. Experts have noted that measuring the time spent on simultaneous activities is a common difficulty in time-use studies, requiring further research (National Research Council 2000).

Advantages of Scanning Technology for Self-Report Time-Use Studies

Despite the limitations of all self-report time-use studies, we believe using scanners has several advantages over other approaches. First, using hand-held scanners eliminates the need for employees to record each activity and note start and stop times. As a result, time is saved and the burden on employees is reduced. In addition, errors are reduced, thus increasing the reliability of the data. Second, employees receive a summary of their workday activities the next day. This lets them make any necessary corrections, again reducing the burden on them and enhancing data reliability. The speed with which the scanned data are transmitted allows for the analysis of the data as the study progresses and for the monitoring of data quality. During the study the researcher can identify employees who seem to have performed one activity for an inordinate amount of time or who may need additional training. This also enhances data

reliability. In addition, the data from the employees are received in electronic format, eliminating the need for data entry, reducing the opportunity for errors and the burden on research staff.

The scanning method may cost about the same as using hand-written timesheets. While we did not track the costs associated with our use of timesheets for one agency, we did receive a proposal to perform a one-month timesheet self-report time-use study for about the same cost as using hand-held scanners.

Potential for Scanning Technology to Improve Government Accountability and Performance

The use of hand-held scanners has the potential to increase the accountability and performance of government agencies. For instance, the Catalog of Federal Domestic Assistance lists about 300 federal programs that require state and local agencies to account for personnel costs in accordance with OMB guidelines, as described earlier (General Services Administration, 2000). Other federal agencies, besides USDA, may permit state and local agencies to employ time-use studies to track these costs. In such cases, state and local agencies could use hand-held scanners to obtain faster, more reliable tine use data for these purposes.

In addition, some federal agencies may also require time-use studies in the near future to improve performance. In response to taxpayers increased demand that tax dollars be spent responsibly, the Congress passed several major statutes, including the Government Performance and Results Act of 1993 (Pub. L. 103-62), which shifts the focus of federal agencies away from such traditional concerns as staffing toward results (General Accounting Office 1996, 1; General Accounting Office 1997, 24-25). The Results Act requires most federal agencies to set goals, measure performance, and report accomplishments (General Accounting Office 1997, 25) The act generally covers executive departments, government corporations and independent establishments (General Accounting Office 1997, 26). To set goals and measure performance, one best practice is for an agency to understand how a program uses its inputs, such as its resources and workload, to produce outputs (General Accounting Office 1999a, 20, 33). By understanding the personnel time required to carry out various processes and activities, the agency can refine workload and processes to improve output. A time-use study conducted using scanning technology could quickly provide program managers with reliable information on how program personnel spend their time, enabling them to better match program inputs with outputs.

For agencies to obtain useful data, time-use studies must be carried out in a deliberate, standardized fashion. Using scanning technology does not eliminate these requirements. Our experience demonstrates that scanning technology can be used for self-report time-use studies and has the potential to make such studies more reliable and less burdensome.

Bar Code System Specifications

Work Management Institute, Ltd. (WMI) of Arlington, Virginia developed the bar code scanning system that GAO used in its time-use studies. This system included Time Wand I® portable bar code scanners produced by Videx of Corvallis, Oregon; a computer with an Intel 80386® processor computer; an ASCII program that tracks the date, time, and barcodes scanned by an

individual; a recharger/modem device; and DOS-based communications software. One recharger/modem device is needed for every 10 scanners. WMI's Quixolve® software program, is used to convert Videx's ASCII data into databases that identify who recorded the data, the date and time, and the barcodes scanned. Quixolve® produces a series of relational databases from a defined protocol. An off-the-shelf report writing software program, integrated into Quixolve®, provided a report template for identifying the time recorded by staff member, summed by position, by department, and by activity. Contractor support is needed to provide initial employee training. Customers then operate the system under an annual site license, accessing technical support if needed.

Many other portable scanning devices that use infrared technology to scan bar codes or text are available. However, we found that the descriptions of other bar code scanners did not indicate if they can capture the time and date with each bar code scanned. Capturing the time and date of each scan is necessary to determine the time spent on an activity. While other hand-held scanners may not eliminate as many steps from the timesheet method as the WMI system, they might be used to partially automate the timesheet approach. For instance, one modestly priced portable scanner, the QuickLink Pen® by WizCom® Technologies, Ltd., can scan document text using optical character recognition (OCR) software and download it to a personal computer via infrared communications or a cable. An agency could use such a scanner along with a timesheet that had a printed list of activities. Each employee would scan text corresponding to the name of the activity and the time he or she began each new activity. The employee's information could be uploaded into a computer and brought into a spreadsheet to calculate the elapsed time for each activity. While this modified scanning approach is more labor intensive than WMI's system, it could minimize some of the transposition errors and the data entry requirements associated with the traditional paper-and-pencil timesheet approach. Given the rapid pace of technological advances, other portable hand-held devices may soon have the both the scanning and clock features to make them suitable for time-use studies.

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