PROJECTED COSTS AND BENEFITS OF ADOPTING ELECTRONIC DATA COLLECTION FOR UNDERGROUND STORAGE TANK INSPECTIONS

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History of The Program

In the early 1970's, environmental regulators recognized that petroleum in underground storage tanks (USTs) was leaking into the environment and contaminating the groundwater. In response, the Environmental Protection Agency (EPA) began to research the causes of the problem and to develop strategies for dealing with it. The EPA published regulations in December of 1988 that required tank owners and operators to protect their tanks from corrosion, prevent spills, prevent overfills, monitor the tanks to detect leaks, and clean up leaked petroleum. South Carolina adopted these regulations and established the Underground Storage Tank (UST) Program within the Department of Health and Environmental Control (DHEC). All active UST facilities were required to register with the Program; approximately 14,000 facilities were registered. Since that time, the UST facility population has dropped to 4,334 as owners chose to permanently abandon their UST systems rather than add equipment required under the regulations.

Situation

As a part of the enforcement of the South Carolina Underground Storage Tank Control Regulations, a team of 12 inspectors and two supervisors from the UST Program inspect each facility in the state on an annual basis. Each inspector inspects, on average, 30 facilities each month. A large amount of data is collected during the inspections and entered into a centralized database from their home computers via telephone connection to the central office. The inherent data transmission speed limitations of the telephone

system results in a process that is both time consuming and expensive. The transfer of data from paper to the database also invites transcription and procedural errors. The supervisors spend a great deal of time each month reviewing 100 percent of the inspections to ensure quality.

Data Collection and Analysis

In order to determine the cost incurred by the Program for our current system, I identified four major cost variables: the amount of time spent on line, the cost of the three 800 lines that support dial-up use, the personnel cost of the on-line time, and the personnel cost of the quality assurance review. Only ten of the inspectors are based out of their homes and use phone lines to access the database. The other two inspectors and the supervisors are based in the central office and have direct access to the database. In calculations of the cost of on-line time, only the ten home based inspectors are considered. Equipment and quality assurance costs are applied to all twelve inspectors and both supervisors.

From May through December of 2003, I collected information on the amount of time that each inspector spent on line doing data entry. This information was collected primarily from itemized phone bills submitted to the Program. The inspectors dial in to the central office system through three 800-number lines. The bills for these lines list each incoming call, the number calling, the time the call was made, and its duration. The cost for each call is charged at a flat, per-minute rate of $.08. From this information, I determined that each inspector spent an average of 17 sessions per month (see Table 1) totaling 6.6 hours (see Table 2) connected to the central office database. The cost of this

time is calculated by adding the cost of phone time and the cost of the personnel. The phone cost was calculated by multiplying 3968 minutes of phone time by $.08 per minute for a total of $317.44 average cost per month. The personnel cost was obtained by calculating the average per-hour cost for our inspectors (see Table 3) and multiplying it the average monthly on line time of 6.6 hours to get a total cost of $103.69 per inspector per month or a total of $1036.86 per month.

To calculate the time for quality assurance, I consulted with the other supervisor and determined that we both schedule five full days per month to review inspections. I calculated our combined per-day salary (see Table 4) and multiplied it by five to obtain a total monthly quality assurance cost of $2059.50.

By adding the monthly costs of the phone ($317.44), inspector personnel ($1036.86), and supervisor personnel ($2059.50), I found that our current system costs the Program $3413.80 per month (Multiplying by 12 yields a total yearly cost of $40,965.60). The cost of our current equipment was not considered since I do not propose to replace it.

Potential Solution

A potential solution for this problem is to employ electronic data collection. Two major advantages of electronic data collection are speed of data transmission and accuracy of data entry. Handheld computers, commonly called PDAs, are powerful and flexible enough to make excellent data collectors. A PDA with the appropriate software could be used to collect the data during a field inspection and then transmit it to the

central office database. In order to determine the feasibility of this solution, I determined the projected costs of operation and compared it to the cost of our current system.

To collect cost and performance information for an electronic data collection system, I consulted with Decision Dynamics Inc, a programming firm currently under contract to DHEC to develop the Environmental Facilities Information System (EFIS) database. Rick Forrest, a programmer with Decision Dynamics, supplied me with the hardware requirements (See Table 5) and estimated performance

I plan to conduct training in three phases: alpha test, beta test, and deployment. The alpha test will require two days for each supervisor and one day for each of three selected inspectors. The beta test will also require two days for each supervisor and one day for each of three selected inspectors. The final deployment will require one day for all 12 inspectors and one day for each supervisor. The costs are estimated at $3622.94 (Table 7)

On January 20, 2004 Decision Dynamics Inc. submitted a bid for development of the software package and yearly support. Software development and staff training will cost $43,000.00. Annual support will cost $3010.00 per year. The UST Program will not be responsible for these costs. This project has the potential for expansion into other Agency programs and for licensing to other state agencies. As a result, the cost of software and support will be funded from the DHEC Information Technology budget. The Underground Storage Tank budget is separate from the Information Technology

Section budget, so for the purposes of this project, software development and support costs are $0.00.

Implementation Plan

An initial version of the software is scheduled for release and alpha testing by April 30, 2004. Three field staff members will be selected, trained, and issued PDAs for use in the test. The PDAs for the alpha and beta testing will be loaned to us by Decision Dynamics at no additional cost. The alpha test is not designed to evaluate the ability of the system to save time and money. It is limited to gathering functionality and usability data for evaluation of the software. The alpha test will begin June 1, 2004. The information to be collected will include usefulness of features, ease of use, speed of data transmission, and accuracy of data transmission. Usefulness of features and ease of use are subjective, so no quantitative data will be collected. The field staff will provide qualitative comments. Diagnostic software will be used to collect speed of data transmission information. Decision Dynamics personnel will collect this data directly. The primary measurements collected by Program staff will be accuracy of data entry. In addition to collecting all of the inspection information on the PDAs, the field staff will continue to collect all of the information from the inspection on paper, using our current standard operating procedures. The field staff will upload the inspection to the database and then forward the paper record to the central office. Central office staff will compare the information uploaded to the database with the paper record. Anything less than 100 percent accuracy is unacceptable. The alpha test will conclude on August 1 and all comments and information will be provided to the programmers by August 15.

Beta testing of the modified software is scheduled to begin on October 1. The same staff that participated in the alpha test will conduct the beta test. Again, usefulness of features, ease of use, speed of data transmission, and accuracy of data transmission will be evaluated. One hundred percent accuracy of data transmission will be the minimum acceptable level. During the beta test, initial information will be collected on the amount of time required on line by the new system. This data will be collected from the phone bill for the three 800 lines. One month of data collected during a test period by three inspectors who are trying to learn to use the system will not be definitive and may not even be representative of potential time savings, but I predict that the amount of time spent per session will decrease. The test will conclude on November 1 and all comments and information will be provided to the programmers by November 15.

The final version of the software is scheduled for release on February 1, 2005. After a two month familiarization period, I will collect phone cost information for eight months and compare it to the data collected from May to December, 2003 to determine how much the time spent on line has changed.

Evaluation Method

During the first 10 months following deployment, I will monitor the phone bill. I will collect the number of sessions on line and the average length of time spent per session. I predict that the number of on-line sessions will rise slightly, but the average length of time per session will drop dramatically. I also predict that exceptionally long sessions will be eliminated. Decision Dynamics Inc believes that the software will

reduce on line time by 50 to 75 percent. I chose 62.5 percent reduction in costs as the mid-point. Cost saving estimates using this amount can be seen in Table 8.

Time spent by the supervisors doing QA/QC will also be monitored. The amount of time required for this activity should begin to drop gradually as confidence in the ability of the field staff to do the job increases. I have chosen the same 62.5 percent reduction in order to calculate cost savings.

Conclusion

If the system is fully deployed on February 1, 2005 and all software costs are funded by non-UST Program funds, then we should recoup all deployment costs and initial equipment costs by July 26, 2005. We have been told to expect a 2 year replacement schedule for the PDAs, so an annual equipment cost of $2733.75 means that we should see a net annual savings of $16,746.65. If the Program should choose to pay the software costs, we would still be able to break even around May, 2007. As a result of my findings, I recommend that the Program proceed with development and deployment of electronic data collection for routine underground storage tank inspections.

ATTACHMENTS

Table 1: Sessions Per Inspector

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inspector A	32	25	36	31	30	21	21	21
Inspector B	23	32	27	24	27	26	27	27
Inspector C	9	9	1	10	18	8	5	7
Inspector D	16	13	23	22	34	21	18	27
Inspector E	18	14	10	15	19	12	6	15
Inspector F	18	18	17	13	12	16	8	5
Inspector G	8	13	3	6	10	14	9	9
Inspector H	12	20	25	22	26	11	9	9
Inspector I	0*	0*	0*	2	27	32	19	18
Inspector J	25	29	22	20	16	14	13	15
AVERAGE	**18**	**19**	**18**	**16**	**22**	**16**	**13**	**15**
COMPOSITE AVERAGE			**17**					

Table 2: Minutes Per Inspector

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inspector A	186.1	351.5	367.4	251.1	310.4	297.5	413.3	320.7
Inspector B	757.6	667.8	925.6	675.9	1143.0	919.9	635.6	744.7
Inspector C	378.2	131.3	162.3	131.9	402.5	431.5	105.7	274.9
Inspector D	708.5	322.9	586.4	358.2	751.5	542.1	440.5	650.4
Inspector E	264.3	207.3	264.7	221.4	302.3	204.3	166.4	177.5
Inspector F	355.6	431.7	362.5	414.4	367.0	385.4	192.0	153.9
Inspector G	225.5	273.8	128.9	150.8	390.9	340.7	379.7	356.2
Inspector H	328.0	236.2	284.5	362.2	328.5	204.6	187.4	155.8
Inspector I	0*	0*	0*	139.5	609.9	882.2	608.1	658.4
Inspector J	477.0	730.2	484.3	436.6	330.5	346.3	318.2	397.5
AVERAGE	**408.8**	**372.5**	**396.3**	**314.2**	**493.6**	**455.4**	**344.7**	**389.0**
COMPOSITE AVERAGE			**396.8 minutes or 6.6 hours per inspector**					

*This position was vacant during these months. Averages for the months of May, June , and July were made assuming only 9 field–based inspector positions.

Table 3: Personnel Cost Per Hour

	Cost*	Hours	Rate
Inspector A	41,408	1,956.5	21.16
Inspector B	41,408		21.16
Inspector C	34,883		17.83
Inspector D	41,408		21.16
Inspector E	34,367		17.56
Inspector F	34,883		17.83
Inspector G	34,883		17.83
Inspector H	34,883		17.83
Inspector I	36,804		18.81
Inspector J	34,030		17.39
AVERAGE	**30,746**		**15.71**

Table 4: Average Personnel (Supervisor) Cost per Month

	Cost *	Hourly	Rate	Days/Month	Cost/Month
Supervisor A	57,093	1956.5	29.18	5	1094.25
Supervisor B	50,381		25.75	5	956.62
TOTAL					**2050.87**
AVERAGE					**1025.44**

* Cost = Salary + Benefits

Table 5: PDA Minimum Capability Requirements

Pocket PC 2003 Format
64MB RAM
Planned Obsolescence – 2 years
400Mhz Processor Speed

Table 6: Equipment Cost*

Dell Axim X3	$329.00
HP iPAQ h2215	$399.99
Average Unit Cost	$364.50

Total Equipment Cost

$364.50 x 15 units** = $5467.50

*The units listed are the 2 most commonly available that meet the minimum performance standards. Prices are as of 1/20/04.

**This number reflects 10 field-based inspectors, 2 office-based inspectors, and 3 units for office staff that regularly assists with inspections.

Table 7: Training Costs

Alpha Test

2 Supervisors x 2 days @ $411.98/day	= $823.95
3 Inspectors x 1 day @ $353.48/day	= $353.48
Total	= $1177.43

Beta Test

2 Supervisors x 2 days @ $411.98/day	= $823.95
3 Inspectors x 1 day @ $353.48/day	= $353.48
Total	= $1177.43

Deployment

2 Supervisors x 2 days@ $411.98/day	= $823.95
12 Inspectors x 1 day @ $1315.80/day	= $1413.90
1 Manager x 2 days @ $239.85/day	= $479.70
Total	= $2717.55

Total Training Cost

Alpha Test	= $1177.43
Beta Test	= $1177.43
Deployment	= $2717.55
Total Cost	= $5072.41

Table 8: PROJECTED COST SAVINGS WITH PDA

PROJECTED PHONE COST WITH PDA

Average Phone Minutes per Month:	1488
Average Phone Cost per Month:	$119.04
Total Yearly Phone Cost:	**$1,428.48**

PROJECTED PERSONNEL COST WITH PDA

Total Minutes Inspector Time per Month:	1488
Total Hours Inspector Time per Month:	24.8
Average Inspector Hourly Rate:	$15.71
Total Monthly Inspector Cost:	$389.61
Total Yearly Inspector Cost	$4675.32
Average Monthly Supervisor Cost:	$640.90
Total Yearly Supervisor Cost	$15,381.60
Average Yearly Personnel Cost	**$20,056.92**

PROJECTED TOTAL COST

Total Phone Cost per Month:	$119.04
Total Inspector Cost per Month:	$389.61
Total Supervisor Cost per Month:	$1281.80
Total Monthly Cost:	$1790.45
Total Yearly Cost (Personnel + Phone)	**$21,485.40**

CURRENT PHONE COST

Average Phone Minutes per Month per Inspector:	396.8
Average Phone Hours per Inspector per Month:	6.6
Total Phone Minutes per Month (average):	3968
Total Phone Hours per Month (average):	66.1
Average Phone Cost per Inspector per Month:	$31.74
Total Phone Cost per Month (average):	**$317.44**

CURRENT PERSONNEL COST

Average Hourly Rate per Inspector:	$15.71
Average Data Entry Time per Month (hours):	6.6
Average Cost per Inspector:	$103.69
Total Monthly Inspector Cost:	$1036.86
Average Hourly Rate per Supervisor:	$27.46
Average QA/QC Time per Supervisor (hours):	37.5
Average Cost per Supervisor:	$1029.75
Total Supervisor Cost per Month:	$2059.50

CURRENT TOTAL COST

Total Phone Cost per Month:	$317.44
Total Inspector Cost per Month:	$1036.86
Total Supervisor Cost per Month:	$2059.50
Total Monthly Cost:	$3413.80
Total Yearly Cost:	**$40,965.60**

PROJECTED COST SAVINGS PER YEAR

$40,965.60 – $21,485.40 = $19,480.20