# A COMPUTER EVALUATION OF THE PHILADELPHIA CURBSIDE RECYCLING PROGRAM

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## ABSTRACT

The purpose of this paper is to present a discussion of a computer system developed to evaluate a voluntary curbside recycling pilot program of a 23,000 residence urban neighborhood in Philadelphia. The curbside recycling program consists of newspaper collection and collection of mixed glass, aluminum and steel beverage containers. Objectives of the analysis of the recycling program include determining its cost effectiveness, efficiency and level of community participation as well as providing direction in determining how and where to expand the program. Extensive field data will be gathered and analyzed with conclusions obtained which will be relevant to others in the industry.

## BACKGROUND

Faced with mounting costs for refuse disposal, the City of Philadelphia made a commitment to implement a recycling program to save money and to extend the life of existing landfills in the region. The City implemented a pilot recycling program in a large middle-class urban neighborhood of about 23,000 households. Recyclable materials were divided into two groups: bundled newspapers and mixed food and beverage cans and bottles. This voluntary program was originally meant to gauge public interest and to measure the feasibility of a citywide program from both an economical and practical standpoint. The success of the program was therefore measured by the percentage of households participating and by the cost per ton of material saved or spent by recycling efforts.

It can be argued that the percentage of households participating is not necessarily a good measure of success since participants will not recycle all their recyclable materials. However, the percentage of participation is a good measure since once households are recycling, they can always be encouraged to optimize the amount or the method. The hardest part in such projects is to get people to overcome their initial reluctance to get involved. At the same time, efforts will be made to determine how much material that was eligible for recycling was "thrown away" by participating households.

Daily variables of the program include: the number of households per block with newspapers; the number with mixed recyclables; daily tonnages of newspapers; daily tonnages of mixed recyclables; daily numbers and hours worked by recycling workers; and the daily number of trips to the recycling plants.

Fixed parameters in the program include: the number of households per block; the workers' hourly wage rates; the tipping fee per ton of mixed recyclables; the revenue per ton of newspapers; displaced cost per ton of material; and census information.

Relevant computed figures derived from the aforementioned variables and values include: the percentage

of households per block with newspapers; the percentage with mixed recyclables; total daily wages and transportation costs; and daily amount of money saved or spent by recycling efforts on both an aggregate and per ton basis. Also, an analysis of the program, based on census information and on the computed information, might suggest an optimal strategy for expanding the recycling program.

The RECYCLE database system was created to assist the evaluation of the pilot recycling program. Constants of the program, such as household and census information, are stored as fixed databases. Daily data are stored in a separate database. Computed data are calculated by the system and stored as databases. Reports and data entry forms are generated from relevant databases. (See Fig. 1.)

Daily data for the pilot recycling program are obtained from two main sources. Cost information, such as the number of recycling workers and total tonnages of recycling materials collected daily are relatively easy to obtain from project managers. Participation information is obtained by data collectors who follow the two special recycling trucks and count the number of households per block that put out each recycled commodity both properly and improperly. Data collectors are given forms, generated by the RECYCLE system, which list every one of the 1400 blocks in the pilot area to guide them in obtaining participation data.

Some of the difficulties in obtaining accurate data involve scavengers. The recycling administration has decided not to ban scavengers from the pilot area, since every ton they handle is that much less for the City forces to collect. The effect the scavengers may have will not be known until the program gets underway. It is assumed that they will be present and will take the most valuable materials. Visual observations of scavengers, if possible, and surveys of households by telephone and in person, may be able to quantify the amounts of recycling material taken by scavengers.

### The Model

To understand the model used, it is necessary to understand a little about how the City of Philadelphia's neighborhoods are laid out and how the building numbers are generated. Market Street is the major street that runs east-west near the midpoint of the city. Much of the city is laid out in a grid that follows the original rectangular plan laid out by William Penn, with numbered streets running north-south and named streets running east-west. Without getting into too much detail, suffice it to say that north-south streets are numare numbered such that the hundred part of the building number refers to the number of major streets north or south of Market Street and that east-west running streets have building numbers whose hundred part refers to the lower of the two adjacent numbered north-south streets. Even in areas such as the pilot area where there are few numbered streets, the east-west streets are numbered as if the numbered streets were extended to that area. For example, the 7100 block of Anderson Street is the section of Anderson Street from Pleasant Avenue to Mt. Airy Avenue, with Durham Street as a minor cross street between them. All buildings on that block will be between 7100 and 7199 with the odd numbers on one side and the even on the other.

The unit of measure for data entry is one "block," which we define as one side of one street for house numbers of a common hundred. Normally, data can be entered either for one side of the street or both, depending on whether the collection crew collects both sides of the street simultaneously or not.

## OVERVIEW OF RECYCLE

RECYCLE is a dBASE III+ database system consisting of a total of 19 program files, 15 database files, plus report formats and screen formats. The system runs on a PC with a hard disk and a floppy disk drive. It is menu driven with many checks built into the system to prevent bad data due to surveyor or keypunch error from invalidating calculations.

RECYCLE is divided into three subsystems: Participation; Costs; and (Census) Tract Analysis. Both the participation and costs subsystems are well developed; knowledge of programming or dBASE is not required to enter data or generate reports. The tract analysis subsystem exists as part of both the participation and costs subsystems. dBASE expertise is required to generate meaningful tract analysis reports.

### Participation

Forms which list all streets by block and route are generated from the address database of the participation subsystem. The data collectors use these forms to count the number of homes per block participating for each recycling commodity. The data collectors also count the number of households per block that put out recycling materials in an unacceptable way. This information is used to judge the effectiveness of public relations and educational efforts. All this information, for each block surveyed, is recorded on the computer generated forms. (See Fig. 2 for sample form.)

The data gathered in the field are entered into the computer via friendly menus and easy to use input

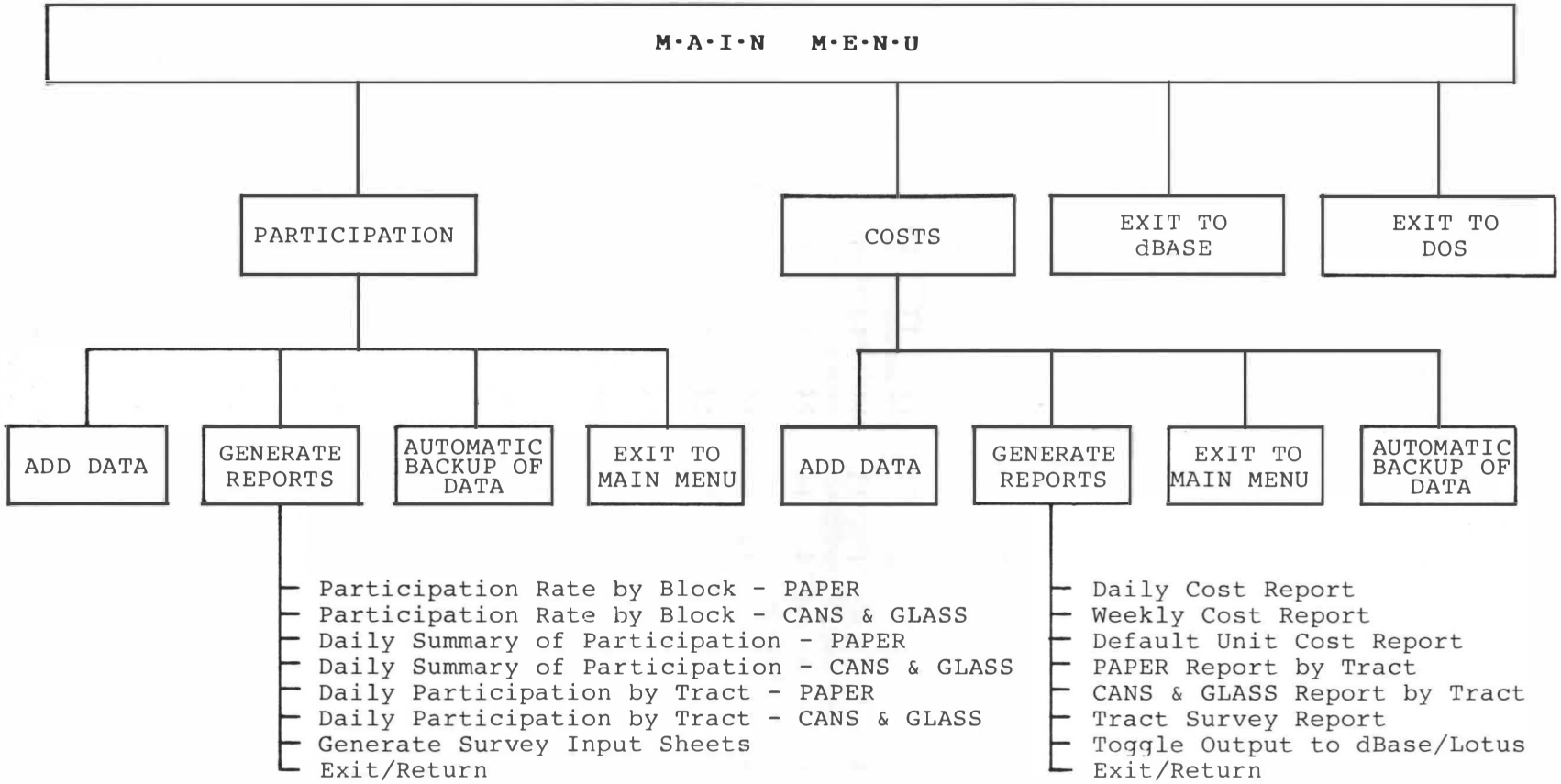


**FIG. 1 RECYCLING DATA**
**(Computer Menu Diagram)**

SURVEYOR LISTING
GERMANTOWN RECYCLING

| STREET | SIDE | ACTUAL PAPER | ACTUAL CANS | REJECT PAPER | REJECT CANS | NOTES |
|---|---|---|---|---|---|---|
| ** WEEK NUMBER: 1 | | | | | | |
| * DAY NUMBER (MON=2 FRI=6) 5 | | | | | | |
| 400 ALLENS LANE | B | [ ] | [ ] | [ ] | [ ] | [ ] |
| 400 ALLENS LANE | E | [ ] | [ ] | [ ] | [ ] | [ ] |
| 400 ALLENS LANE | O | [ ] | [ ] | [ ] | [ ] | [ ] |
| 500 ALLENS LANE | B | [ ] | [ ] | [ ] | [ ] | [ ] |
| 500 ALLENS LANE | E | [ ] | [ ] | [ ] | [ ] | [ ] |
| 500 ALLENS LANE | O | [ ] | [ ] | [ ] | [ ] | [ ] |
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| 600 ALLENS LANE | O | [ ] | [ ] | [ ] | [ ] | [ ] |
| 900 ALLENS LANE | E | [ ] | [ ] | [ ] | [ ] | [ ] |
| 900 ALLENS LANE | O | [ ] | [ ] | [ ] | [ ] | [ ]A-SAME ALLEY AS 900 WADSWORTH EVEN |
| 6300 ANDERSON | B | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6300 ANDERSON | E | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6300 ANDERSON | O | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6400 ANDERSON | E | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6600 ANDERSON | O | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6700 ANDERSON | B | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6700 ANDERSON | E | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6700 ANDERSON | O | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6800 ANDERSON | B | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6800 ANDERSON | E | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6800 ANDERSON | O | [ ] | [ ] | [ ] | [ ] | [ ] |
| 6900 ANDERSON | O | [ ] | [ ] | [ ] | [ ] | [ ]6921 AND 6925 IN ALLEY |

FIG. 2 SURVEYOR LISTING
(Germantown Recycling)

screens. At the beginning of a data entry session, the route is identified by the computer operator. Afterwards, if a street or block number is entered which is not on the day's route, the data will not be accepted. For each block, the total number of residences is in the address database so that any attempt to input a participation number greater than the maximum on that block will not be acceptable. Many similar checks are incorporated into the system in an attempt to eliminate bad data from getting into the database. Every effort is made to prevent the entry of errors into the database using range filters and asking for data verification at crucial junctions. The program is structured such that incomplete participation data will not affect the total participation percentages reported. The participation percentages are calculated based on the survey sample. The participation reports show the participation percentages for each block surveyed or for the daily total of all blocks surveyed.

### Costs

In order to calculate the operating costs of the curbside recycling program, all of the cost parameters are entered via one of the selections from the cost menu. Daily data entered into the system include: truck costs; number of trips to the recycling plants; daily tonnage of newspapers; daily tonnage of mixed recyclables; and the number of recycling workers and hours worked. Fixed figures of the program include: toll cost for one round trip for a truck; revenue per ton of newspapers; tipping fee per ton of mixed recyclables; and the workers' hourly wage rates. Default values for recycling constants are entered initially. At each data input session the defaults are displayed for the operator to accept or revise. Once the cost and tonnage figures are entered, the program automatically does all necessary calculations and generates cost reports. The default rates used in calculating costs are saved in a separate file for future reference and analysis.

### Tract Analysis

Census information is available from the Census Bureau which breaks down the statistics of neighborhoods into small units called tracts. Census tracts contain five to ten city blocks. Since each block in the pilot area belongs to one tract, it is possible to relate participation data with such things as average income, education, race, number of people on Social Security, or numbers of people per family.

Generalizations regarding which statistical profiles are best candidates for recycling efforts can be made by coming up with hypotheses which seem reasonable and testing them against the data. For example, one might want to test the hypothesis that poorer tracts participate to a greater extent than the average. The correlation might prove to be positive or negative.

The tract analysis subsystem generates two participation databases organized by date and tract number, one database for each commodity. To test the aforementioned hypothesis, a user with dBASE expertise relates the census tract database, the child file, to one of the two tract participation databases, the parent file, by a common field, such as tract number. The user then lists participation fields, such as participation percentage, and relevant census fields, such as average income, for tracts with greater than average participation and for tracts with less than average participation. The user applies statistical tests to test the correlation, if any, between income and participation.

Income is not the only census information available. Age, family size, education levels, and race might also be parameters that one might want to test for correlation with participation.

Statistical patterns may emerge from tract analysis that will be helpful in understanding which neighborhoods are most likely to participate well in any future programs. Tract analysis might also show profiles of neighborhoods less likely to participate. Reasons for poor participation can be hypothesized and tested based on tract analysis information. We expect tract analysis conclusions will be most useful in helping us and others in targeting prime areas for recycling or in finding statistical patterns for low participation.

## CONCLUSIONS

This paper has described a database application generated using dBASE III+ to help evaluate the success of the Philadelphia curbside recycling program. Without getting into programming details, it was demonstrated what parameters could be captured and how they could be used to measure program success and to help predict which neighborhoods would be most likely to participate in future programs. Much of what has been done can be modified to suit other cities and towns, but a good knowledge of dBASE III+ will be required.

## ACKNOWLEDGEMENT

dBASE III+ is a registered trade mark of the Ashton-Tate Co., Inc.

**Key Words:** Computer Evaluation; Curbside Recycling; Database; dBASE III+; Municipal Refuse; Philadelphia; Recycling; Refuse