The City Carrier Street Time Study

A Presentation to the Postal Rate Commission

December 3, 2003

Why A New City Carrier Street Time Study?

- The data used to support cost attribution in the CRA were dated.

- Old special studies lead to high CVs.

- PRC criticized the city carrier special studies for limited sample sizes, study design problems, and econometric deficiencies.

  – The PRC pointed out they are not a system-wide approach.

  – The PRC has criticized some of the special studies for using simulated instead of actual carrier behavior.

  – The old method required linking together the results of different special studies, which could be inconsistent.

Goals of the New Study

Tailor the analysis to PRC methods and requirements.

Focus on a system-wide approach.

Increase accuracy: Avoid bias and reduce variance.

Draw data in accordance with good statistical practice.

Collect data from live carrier operations. Reflect current operations.

Avoid prohibitive cost so as to promote updates.

Construct a study architecture consistent with regular updates.

Be consistent with ongoing USPS city carrier data collection efforts.

Overview of the Study

Measure volume variable street time by class and subclass

Step 1:
Form time / cost pools representing street time activities.

Step 2:
Measure volumes, by shape, that are collected and delivered.

Step 3:
Measure the relationship between activity time and volume by shape.

Step 4:

Distribute volume variable cost by class and subclass.

Research Work Plan

- Design the Study.
- Determine Sample Size And Method Of Data Collection
- Initial Training
- Beta Test
- Review Beta and Refine Study
- Final Training
- Data Collection
- Compile and Prepare Data
- Specify Econometric Models
- Calculate Cost Pools
- Estimate Variabilities
- Distribute Volume Variable Costs

Step 1:

Form time / cost pools
representing street time
activities.

Defining Street Time Activities

Goal: Define a set of activities consistent with carrier operations that are measurable and complete.

Discussions with operations experts revealed:

1. Street time delivery is done in "sections."
   Curbline   Park & Loop/Foot
   Dismount   NDCBU
   VIM   Central/Apartment

2. Parcels and Accountables cause retraces and customer contact.

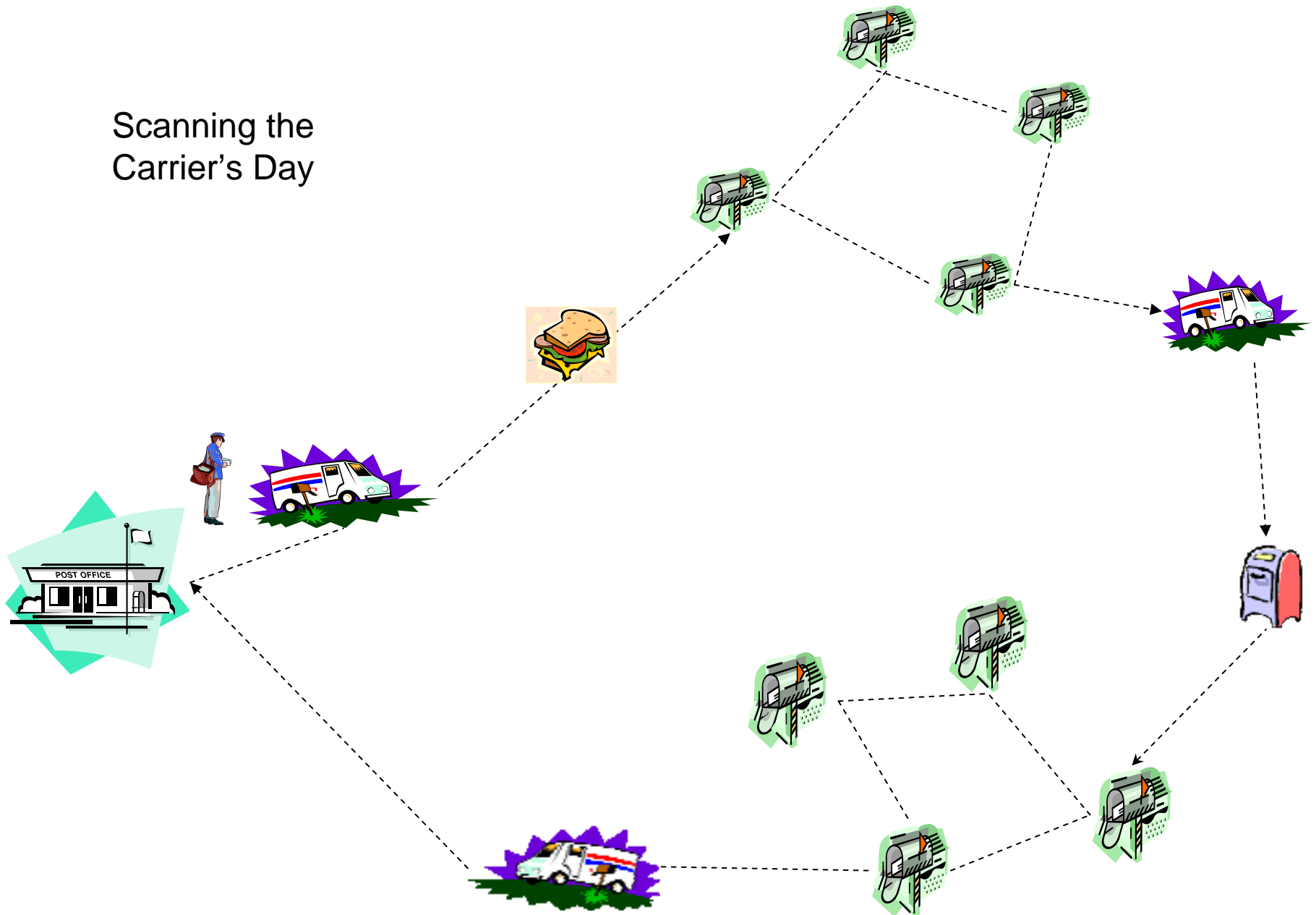3. "Access" and "Load" are not separable activities.

4. Carriers have a set of non-delivery activities that occur at specific locations:
   Relay boxes
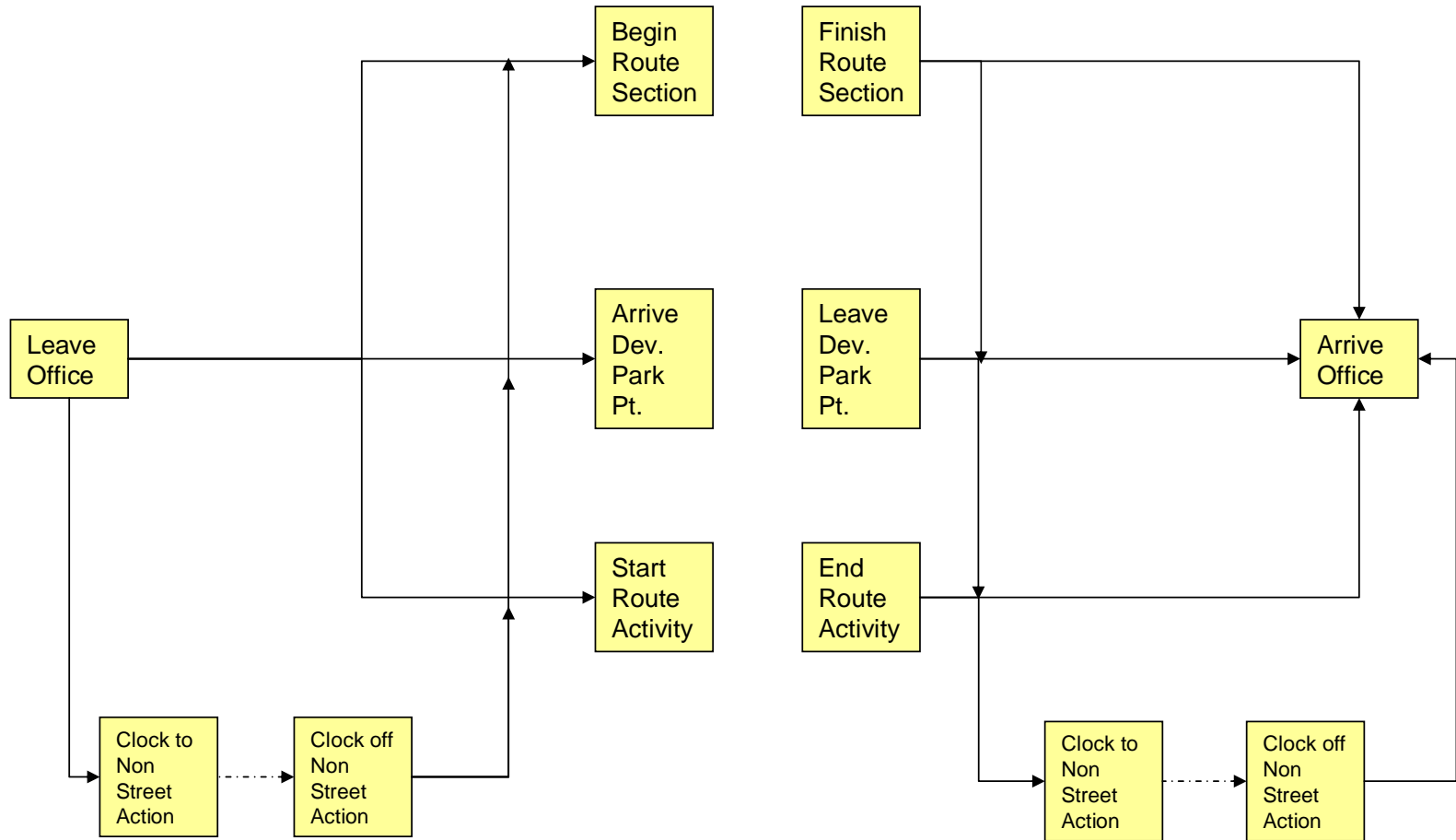   Preparation
   Collection at SLB

Scanning the Carrier's Day

- Cost pools are defined by sets of successive scans.
- All carrier street time is included.
- Carriers "self scan" using DC scanners.
- All sets of scan pairs were analyzed and activity pools defined.
  - 36 individual scans -- 1296 pairs were analyzed & defined.
- Most sets of scan pairs are "illegal."
- Scans pairs must be "complete."
  - All "Begin Delivery" scans must have a "Finish Delivery" scan
  - All "Start Activity" scans must have an "End Activity" scan
- Appropriate "nesting" is allowed.
  - Parcel/accountable delivery can occur within a section.
  - Lunch or break can occur in any activity.

Scanning the
Carrier's Day

Measuring "Travel to and From the Route" Time

| Leave Office | | Begin Route Section | Finish Route Section | | Arrive Office |

Boxes and flow:

- Leave Office
- Begin Route Section
- Finish Route Section
- Arrive Dev. Park Pt.
- Leave Dev. Park Pt.
- Arrive Office
- Start Route Activity
- End Route Activity
- Clock to Non Street Action
- Clock off Non Street Action
- Clock to Non Street Action
- Clock off Non Street Action

Defining Time Pools

- Prep
- Travel to & from Route
- Delivery Within Curbline Sections
- Delivery Within P&L/Foot Sections
- Delivery Within Dismount Sections
- Delivery at NDCBU Sections
- Delivery at VIM Sections
- Delivery in Central/Apartment Sections

- Travel Between Sections or Activities
- Parcel / Accountable Delivery
- Travel for Deviation Delivery
- Relay Boxes
- Collection at SLB (Express & Regular)
- Other (Break, etc.)
- Off Clock (Lunch, etc.)

Data Collection Effort

- National random sample.
- Data were collected at over 150 ZIP Codes.
- All routes in each ZIP Code were sampled.
- Over 3,400 routes were tested.
- Data collected for 2-week period, May-June 2002
- Over 35,000 route-day observations.
- Data were collected on carrier activities and volumes on each route.

Street Time Proportions

Activity	Percentage of Time
Loop/Foot Delivery	30.71 %
Curbline Delivery	13.20%
NDCBU Delivery	5.15%
VIM Delivery	0.21%
Central Delivery	6.09%
Dismount Delivery	10.68%
Prep	4.79%
Travel To/From Route	8.32%
Network Travel	10.41%
Deviation Delivery Travel	0.47%
Parcel/Accountable Delivery	4.68%
Relay	1.25%
General Collection (SLB)	0.22%
Express Collection (SLB)	0.02%
Other (Break, etc.)	3.78%

Average Street Time Per Route:

5.49 hrs. (including lunch)

5.17 hrs. (excluding lunch)

Step 2:

Measure volumes, by shape, that are collected and delivered.

Collecting Volume Data

Volume data were collected on the same routes and days during which scans were collected.

Letters, Flats, and Sequenced Mail data were collected from Postal Service data systems.

Parcels, Accountables, and Collection volumes data were collected through a mail count for each route on a daily basis.

All data were double punched and verified.

Average Daily Volumes Per Route

	Pieces	Per Delivery
Letters	1,870.6	3.82
Flats	602.0	1.23
Sequenced	180.4	0.37
Parcels	27.4	0.06
Accountables	3.4	0.01
Delivery Points	489.7	

Step 3:

Measure the relationship between activity time and volume by shape.

Econometric Methods

Estimation is done at the Zip Code (Delivery Unit) Level
  -- This is where management decisions are made.
  -- Allows for all responses in carrier time to volume changes.
  -- Resolves the "8 hour day" problem.

Model Specification: Generalized Quadratic
-- Permits but does not impose returns to scale and scope.
-- Effective at dealing with zero volumes.
-- Consistent with the PRC Econometric Load Time specification
-- Dominant part of attributable delivery time.

Separate Equations Regular Delivery and P/A Delivery
  -- Allows accurate estimation of retrace and customer contact.
  -- Accounts for relatively small parcel & accountable volumes.

Route adjustment process was explained by the PRC in its Opinion in Docket No. R80-1:

"Volume changes cause the amount of carrier time devoted to certain activities to change -- thus, total carrier time changes. Because of constraints and goals, such as the desire to equalize workload and limits on the amount of carrier work time per day, volume changes can result in route adjustments."

The Econometric Models

Regular Delivery Time

$$
\begin{aligned}
DT_{it} \ = \ & \beta_0 + \beta_1 L_{it} + \beta_{11} L_{ij}^2 + \beta_2 F_{it} + \beta_{22} F_{ij}^2 + \beta_3 S_{it} + \beta_{33} S_{ij}^2 \\
& + \beta_4 C_{it} + \beta_{44} C_{ij}^2 + \beta_5 SP_{it} + \beta_{55} SP_{ij}^2 + \beta_6 DP_i + \beta_{66} DP_i^2 \\
& + \beta_7 DN_i + \beta_{77} DN_{ij}^2 + \beta_{12} L_{it} * F_{it} + \beta_{13} L_{it} * S_{it} + \beta_{14} L_{it} * C_{it} \\
& + \beta_{15} L_{it} * SP_{it} + \beta_{16} L_{it} * DP_i + \beta_{17} L_{it} * DN_i + \beta_{23} F_{it} * S_{it} \\
& + \beta_{24} F_{it} * C_{it} + \beta_{25} F_{it} * SP_{it} + \beta_{26} F_{it} * DP_i + \beta_{27} F_{it} * DN_i \\
& + \beta_{34} S_{it} * C_{it} + \beta_{35} S_{it} * SP_{it} + \beta_{36} S_{it} * DP_i + \beta_{37} S_{it} * DN_i \\
& + \beta_{45} C_{it} * SP_{it} + \beta_{46} C_{it} * DP_i + \beta_{47} S_{it} * DN_i + \beta_{56} SP_{it} * DP_i \\
& + \beta_{57} SP_{it} * DN_i + \beta_{67} DP_i * DN_i + \varepsilon_{it}
\end{aligned}
$$

Where:

L	=	Letters
F	=	Flats
S	=	Sequenced Mail
C	=	Collection Mail
SP	=	"Small" Parcels
DP	=	Delivery Points
DN	=	Density: Delivery Points per Square Mile

The Econometric Models

Parcel/Accountable Delivery Time

$$\text{PADT}_{it} = \beta_0 + \beta_1 \, \text{LP}_{it} + \beta_{11} \, \text{LP}^2 + \beta_2 \, A_{it} + \beta_{22} \, A^2$$

$$+ \beta_3 \, \text{DP}_i + \beta_{33} \, \text{DP}^2 + \beta_{12} \, \text{LP}_{it} * A_{it}$$

$$+ \beta_{13} \, \text{LP}_{it} * \text{DP}_i + \beta_{13} \, A_{it} * \text{DP}_i + \varepsilon_{it}$$

Where:

LP = "Large" Parcels
A = Accountables
DP = Delivery Points

Econometric Results

Regular Delivery

	Zip-Day Mean	Elasticity
Letter	35,317.00	20.7%
Flat	11,455.43	8.8%
Sequence	3,469.21	2.3%
Collection	5,134.68	6.6%
Small Parcel	368.01	1.4%
Delivery Pts.	9,318.52	67.3%
Density	72.84	-8.7%
R^2	0.8190	
# of obs	1,495	

Combined Variability is 39.8%

Econometric Results

Parcel/Accountable Delivery

|	Zip-Day Mean	Elasticity
Large Parcel	141.30	26.8%
Accountable	57.79	25.3%
Delivery Pts.	8,067.43	49.9%
R^2	0.7058	
# of obs	1,475	

These costs explicitly account for deviation deliveries, retraces, and customer contact.

Volume Variabilities By Cost Pool

Activity	Variability	Method
Regular Delivery	39.8%	Econometric Model
Prep	na	Office Time
Travel To/From Route	40.7%	Burden Method
Network Travel	0%	Fixed
Parcel/Accountable Delivery	52.1%	Econometric Model
Relay	40.7%	Burden Method
General Collections	36.9%	PRC Method R2000-1
Express Collections	0%	PRC Method R2000-1

Step 4:

Distribute volume variable cost by class and subclass.

Cost Pools are by shape
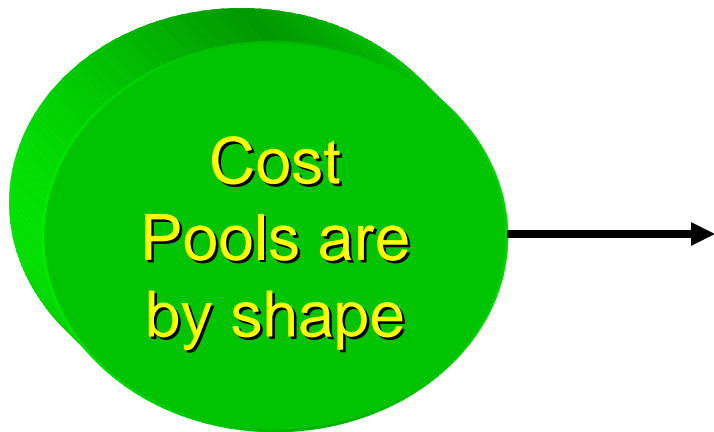
Regular Delivery: Letters, Flats, Sequenced Mail, Small Parcels, Collection

P/A Delivery: Large Parcels and Accountables

Use CCS to distribute to class

Letter Cost Pool

STD A Non Profit
13%

FCSP
26%

STD. A ECR
20%

STD A. Reg
10%

FCPSRT
31%
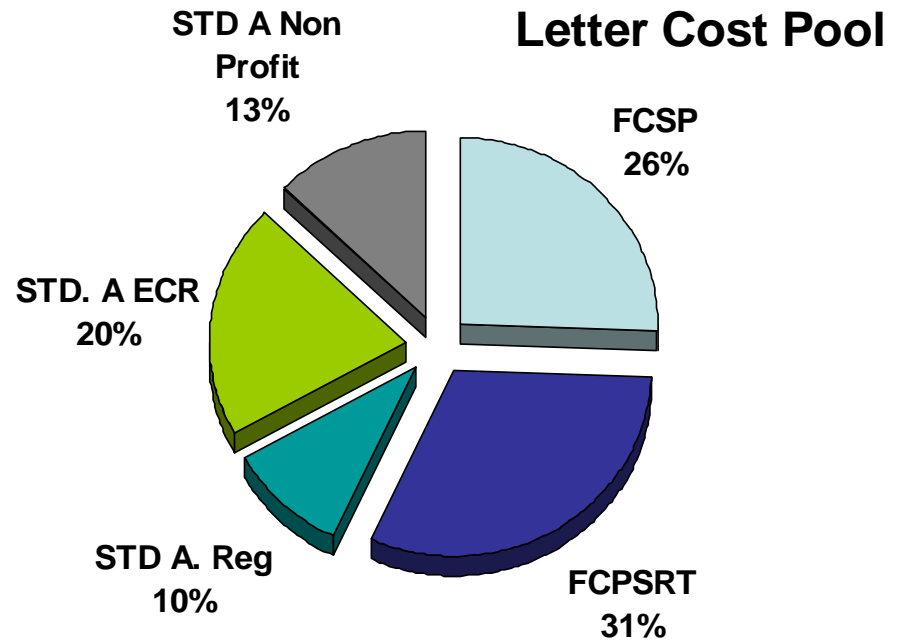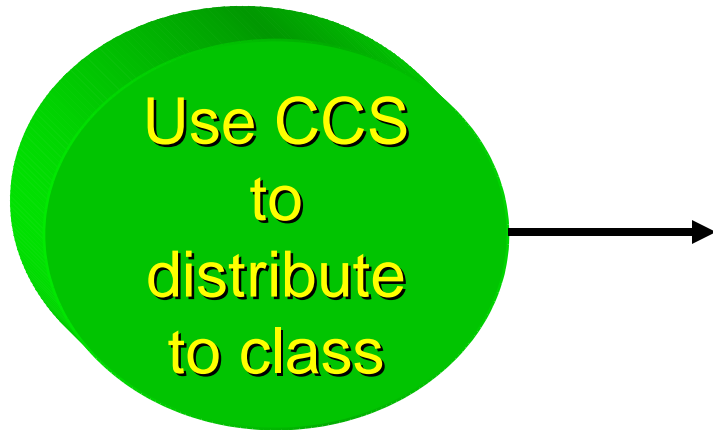
Conclusion

- Operational sound, statistically reliable study.

- Consistent with PRC requirements

- Improves accuracy, reflects actual carrier activity.

- Potentially updateable, possible links to Postal Service data systems.