# AUTOMATED WASTE COLLECTION – HOW TO MAKE SURE IT MAKES SENSE FOR YOUR COMMUNITY

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## ABSTRACT

The decision to implement solid waste collection automation is a complex one and involves a number of factors that should be considered, including engineering, risk management, technology assessment, costs, and public acceptance. This paper analyzes these key issues and provides a case study of how waste collection automation was considered by the City of Lakeland, Florida.

## HOW DID AUTOMATED COLLECTION GET STARTED?

The evolution of solid waste collection vehicles has been historically driven by an overwhelming desire by solid waste professionals to collect more waste for less money, as well as lessening the physical demands on sanitation workers. Evolving from horse drawn carriages and human powered carts to motor operated vehicles, collection equipment has been modernized, but it was not until the 1960s in the United States, however, that solid waste collection took a monumental leap in technology to improve overall efficiency.

During this era, public works departments in communities in mostly western states, which were experiencing rapid customer growth in suburbia in the post-World War II period, were exploring the concept of improving their labor productivity with their oftentimes limited resources. It is important to point out that these cities and agencies were less constrained by formal labor agreements, which were more typical of their larger sister, communities in the east and Midwest. Consequently, they began to explore ways of moving in the direction of improved vehicle automation as a substitute for labor to lift, tip, and empty garbage containers that were placed curbside.

Automated side-load trucks were first implemented in the City of Phoenix in the 1970s with the aim of ending the back-breaking nature of residential solid waste collection, and to minimize worker injuries. Since then thousands of public agencies and private haulers have moved from the once traditional read-load method of waste collection to one that also provides the customer with a variety of choices in standardized, rollout carts. These automated programs have enabled communities throughout the country to significantly reduce worker compensation claims and minimize insurance expenses, while at the same time offer opportunities to workers who are not selected for their work assignment based solely on physical skills.

## MODERN APPLICATION OF AUTOMATION

In an automated collection system, residents are provided a standardized container into which they place their waste. Residents must place their cart at the curb on collection day. During collection, the driver positions the collection vehicle beside the cart. Using controls inside the cab of the vehicle, the driver maneuvers a side-mounted arm to pick up the container and dump its contents into the vehicle. The driver then uses the arm to return the container to its original location. Automated collection allows for the driver to service the entire route; the need for additional manual labor is eliminated. The savings in personnel and worker's compensation costs, as well as the increase in crew productivity for automated collection, are well documented throughout the solid waste industry.

Currently, the Waste Equipment Technology Association (WASTEC) estimates that there are roughly about 120,000 solid waste vehicles on the road in the United States and about 15% of all new waste collection vehicles purchased in 2003 (the most recent statistics available) were automated. This trend is rapidly increasing as many agencies and private haulers shift to

automation in an attempt to minimize increasing insurance costs and more effectively control their cost of labor, while at the same time provide increased customer service levels and opportunities for an aging work force.

## ADVANTAGES AND DISADVANTAGES OF AUTOMATION

Some of the general advantages of automated collection often touted by its proponents include the following:

**For Residents**

- Convenient and easy method for residents to dispose of trash.
- Wheeled containers are easier, more maneuverable, and safer for residents because there is no carrying or lifting of heavy trash cans.
- The capacity of most cans provided in these programs is equal to three or four regular trash cans.
- The containers keep rodents and pets out of trash given the tight lids.
- Helps to eliminate "over service," as carts have a finite capacity as compared to manual bag programs.
- Containers are provided by and maintained by the community or hauler.
- Cleaner, healthier neighborhoods with no litter on streets after pickup.

**For the Municipality**

- Improved collection efficiency and reduced costs
- Reduced employee injuries.
- Lower turnover rate and increased productivity due to less time missed by injured employees.
- Reduced Worker's Compensation claims and insurance premiums.
- Reduced rodent problems.
- Cleaner, healthier neighborhoods with no litter on streets after pickup.
- Volume based containerized system helps limit overages.

## IMPROVING SAFETY AND REDUCING WORK INJURIES

Solid waste collection workers are highly exposed to health and environmental safety risks due to exposure to heavy workloads, volatile compounds, potentially hazardous or even infectious materials. Typical rear-load operations require manually lifting materials into the collection vehicles. Statistics from such programs suggest that collection crews lift on average, over six tons (13,000 lbs.) per worker per day. In general, this heavy, repetitive, manual lifting combined with an aging workforce tends to generate an increasing number of injured staff.

A fully automated collection program enhances worker safety and comfort, minimizes manual lifting and exposure to possible hazards in the waste such as sharp objects. Fully automated collection eliminates heavy lifting, walking between setouts and frequent steps on and off the truck. The mechanical arms on modern, fully automated trucks are typically operated by the driver using a joystick control. Rather than slogging through rain and high temperature environments, operators of automated refuse collection systems spend their shifts in climate controlled comfort. The reduced physical requirement increases the diversity and longevity of the workforce that is able to collect waste. Automated collection has proven to significantly reduce collection worker injuries resulting in reduced workers compensation costs, decreasing disability claims, decreasing the number and cost of light duty assignments, and reducing salary fringe benefit costs in the future.

Automated collection programs are designed for right-side only collection routing. Similar to mail carrier routes, vehicles are forced to collect along the curb line making right hand only turns during its collection route. This right-hand only routing scheme enhances safety, reduces the number of unprotected left hand intersection turns, and eliminates the unsafe practices of zigzagging and double-sided collection commonly seen in rear end load collection systems.

## ENABLING VARIABLE RATE STRUCTURES

Under the traditional manual collection system, customers in most communities are typically allocated a basic service level of two cans for garbage collected twice weekly. Those homeowners that are ardent recyclers and who reduce waste and regularly set out less than two full cans of garbage oftentimes do not see any savings as they pay the same as those residents that use two full cans.

Most communities have found that implementation of automated collection provides an opportunity to supply their customers with varied container sizes and thereby moving closer to a true utility-like user pay for garbage disposal system (pay-as-you-throw or "PAYT") where residents pay only for the service they need. Tailoring the size of the cart to the amount of garbage produced

and charging a higher cost for larger garbage cart sizes encourages residents to recycle and reduce the amount of waste disposed.

## ENVIRONMENTAL AND AESTHETIC BENEFITS

The use of standardized containers for automated collection has proven to result in a number of clear environmental benefits. The rolling carts are more resistant to animals, thus reducing unsightly blowing litter and strewn garbage, and replaces unsightly set-outs with a single uniform container over an entire community. The carts are designed with closed lids which help to reduce odors and keep water out, reducing leakage from trucks and water weight at landfills. Automated yard trash collection programs also eliminate the need for residents to use plastic bags which end up in the landfill and reduce the quality and usability of mulch products while providing residents with a convenient wheeled cart to collect debris while landscaping.

### Enhanced Level of Service

Automated solid waste collection is considered a higher level of service (versus manual collection) for residents. For most residents, wheeled carts are easier to move and set out than cans and bags that must be lifted. The wheeled containers are extremely durable, often lasting ten years or more, and are convenient to use as residents no longer need to buy replacement garbage cans or plastic yard trimmings bags. In most cases, carts are owned and maintained by the jurisdiction or servicing hauler.

## DISADVANTAGES OF AUTOMATED COLLECTION PROGRAMS

The primary disadvantage of automated collection is the initial costs of purchasing specialized vehicles and providing carts to homeowners. On average, the capital cost of an automated side-load vehicle is 20 percent more than that of a manual rear load vehicle. Additionally, the useful life of an automated vehicle is often less than a rear load vehicle. Cart costs generally average between $35 and $50 each depending on container size. Additional general disadvantages include the following:

- Automated vehicles require more maintenance than traditional rear end load vehicles and require specialized training of technicians.
- Homeowners must be educated on where to place bins and what kinds of trash can be collected. Bulky items that do not fit in the cart usually require a separate collection. Overloaded containers, or waste left on the ground can impact the productivity of collection. Ordinances prohibiting waste left on the ground should be developed, while additional containers or additional bag fees can help cover or discourage the practice.
- Some cities have chosen to automate yard waste collection as part of a transition to automation; however the size and volume of yard waste makes it less conducive to cart programs, and typically requires separate collection with different vehicle types (claw-type trucks or rear end load units). In order to effectively automate yard waste collection, yard waste size limits must be enforced, and alternate methods developed to collect larger, bulk debris items. Some jurisdictions have instituted a volume-based fee for yard waste that exceeds a predefined limit, making the system conducive to automation.
- Automated collection does not work in densely populated areas with on-street parking on collection days. However, on-street parking does not prevent a cart based approach to collection. A hybrid system can be employed in these cases where carts are collected in a semi-automated fashion and many cart system benefits can still be enjoyed.

## CASE STUDY TO ANALYZE IMPLEMENTATION FEASIBILITY

Last year, the City of Lakeland, Florida studied the feasibility of converting to an automated collection program for single-family, residential customers. Residential garbage collection for some 43,000 accounts is currently performed twice weekly with two separate routes structures (Monday/Thursday and Tuesday/Friday). Utilizing rear-end load compaction vehicles, 15 trucks are deployed on the Monday/Thursday routes, and 14 trucks are deployed on the Tuesday/Friday routes. Three-man crews are utilized on each of these routes including one driver and two loader collectors. Data indicated that setouts on the lead or first day of collection average about 80 percent, while the average setout rates on the trail or second day of collection is 58 percent.

**INSURANCE CLAIMS**

With manual collection, worker's compensation claims had escalated over the past five years (Table 1) with the most significant claims dealing with knee/ankle/wrist and back injuries.

TABLE 1
WORKER'S COMPENSATION CLAIMS FOR SOLID WASTE OPERATIONS 2005- 2009

| Type of Injury | Number of Claims | Total Compensation ($) |
|---|---|---|
| **Back/Neck** | 388 | 139,124 |
| **Eyes** | 60 | 4,474 |
| **Fall or Thrown from Vehicle** | 90 | 21,695 |
| **Groin** | 33 | 27,136 |
| **Hopper** | 8 | 614 |
| **Insect Bite** | 51 | 5,042 |
| **Knee/Ankle/Leg** | 1,316 | 828,673 |
| **Laceration or Stab** | 67 | 8,825 |
| **Miscellaneous** | 126 | 22,756 |
| **Shoulder** | 323 | 120,951 |
| **Toes/Foot** | 29 | 2,523 |
| **Wrist/Elbow/Arm** | 148 | 23,544 |
| **Total** | **2,639** | **1,205,356** |

CITY OF LAKELAND, FLORIDA

A Pro-Forma Model was constructed to help estimate the projected costs to the City to implement an automated, solid waste collection program. The Model estimated the financial impact of implementing an automated collection program that included once weekly collection of 95-gallon containers and once weekly collection of yard waste using the existing rear-end load system. The model did not include costs associated with the collection of curbside recyclables, as revenues are separate from garbage and yard waste collection.

**Model Assumptions**

The following assumptions were utilized to construct the Lakeland Model. Although the reader's mileage may vary, each of these items is important to consider when considering a conversion to automation:

- 43,000 residential customers.
- 90 homes per hour rate of production. Although higher production rates can be achieved with automation (up to 120 homes per hour), the City should not expect to reach higher levels until system is fully implemented, staff is fully trained, and education and outreach programs have demonstrated effective results.
- Four-day work week (garbage).
- Four-day work week (yard waste).
- Yard waste production estimates based on the City's current actual experience.
- Labor cost assumptions based on the median of salary ranges as provided by City, escalated 3% for 2010 CPI.
- Benefit costs calculated at 35% of total salaries.
- Fuel usage was based on per unit FY 2009 budget estimates. Fuel costs based on Energy Information Administration (EIA) average for low sulfur diesel for previous 2 years.
- Three-person yard waste routes (1-driver, 2-crew).
- Model does not consider revenues from sale of surplus equipment (can be factored into new purchases – City estimates a 40 percent residual value).
- Vehicle spare (backup) ratios calculated at 15%.
- Manpower backup ratio calculated based on City provided time off (vacation & sick time) benefits.
- Automated containers are depreciated for 10 years (coinciding with factory backed warranty of 10 years).
- Spare ratios for carts calculated at 5 % for spares and replacements.
- Self-insurance cost reduction estimated at 30% of current City experience. Rear load collection

exposure is projected to remain at 20% to account for continued manual yard waste collection.

**Projected Results**

The team was asked to conduct a financial analysis of the residential solid waste and yard waste system. To conduct this analysis, administrative costs (approximately $3.2 million), those that are considered part of the entire department, needed to be allocated to the residential services portion of the system in order to recognize a true cost of operations. The residential administrative allocations ($1,582,231) include the current costs experienced by the City and were allocated by a variety of methods including number of trucks, staffing, and percent of revenue, depending on the cost category. A minimum of 30 percent savings in the self-insurance fund was estimated to occur in the first year of automation. Similar systems have recognized greater than 50 percent in some cases. Figure 1 illustrates that with the assumptions in place, the City can reduce overall operating expenses by converting to automated collection. The monthly per household cost can potentially be reduced by $1,220,862, an estimated $2.06 per month from the current FY 2009 cost of $15.82. However, it is up to the City's elected officials to determine if the savings should be used to stabilize utility rates in future years, or if the savings can be immediately passed through to residents. The project also illustrated that the current cost to operate is currently higher than monthly residential fees charged ($15.75), and that the residential system is being subsidized by the City's commercial collection system.

FIGURE 1
ESTIMATED FINANCIAL RESULTS
CITY OF LAKELAND, FLORIDA

| Factors | Current Program | Automated Program |
|---|---|---|
| Staffing | 64 | 35 |
| Vehicles | 26 | 24 - 22 |
| Collection Frequency | 2 X Week | 1 X Week |
| Cost ($/Month/Home) | $15.82[1] | $14.32 - $13.45[2] |
| Potential System Savings | | $774,326 - $1,220,862 |

*Cost to operate is currently higher than monthly residential fee ($15.75). Residential rates are currently subsidized by commercial collection system.
**Projected rates (first year to full implementation)

Following meetings with City staff, the first model was further adjusted to account for no reduction in administrative costs using a current residential system allocation amount provided by the Division of $1,749,784. Applying this allocation method, the City can conservatively reduce the monthly per household cost by an estimated $1.73 per month. The majority of these savings can be seen in the personnel expense category, as the FTE headcount is reduced by approximately 20. This change to automated collection is projected to result in a cumulative first year savings for the Division as a whole of $774,326 in 2009 dollars. These total savings will not be fully recognized until the entire system has been converted to full automation.

**Implementation Issues**

**Phase In Approach:**

Implementing an automated collection program should preferably be in a series of steps. Implementation should be done in a phased in approach; adding subdivisions and areas of the City to the program over time. In most cases, implementation begins with a pilot program where a small consolidated sector of the city is converted to the new system. This sector size is based roughly on the collection capacity of one vehicle (900 – 1200 households), and is typically an active community with a high level of residents involved in the local community. Homeowner association meetings, mailings, and promotional activities are conducted three to six months in advance in order to brief the residents on the program, and feedback is solicited from the residents during the process in order to help anticipate future questions. Once the pilot community is active with the new system for at least three months, planning can begin on a full scale phased in implementation. The benefits to a phased in approach include:

- Acclimating residents to the program organically and not concurrently - Except for the first city area to be converted, other residents will be exposed to ongoing education and outreach programs about the new system and will have an understanding of the program when their neighborhood is ready for conversion. Also, a phased-in approach will allow the City to adjust program education based on initial feedback from the pilot program residents.

- Provides an opportunity for better capital management - A phased in approach to citywide conversion allows for the phased in purchase of new collection vehicles, rather than purchasing all at the same time. As vehicles age, the cost to repair increases, and at some future point, all vehicles again have to be replaced. In a phased approach, new vehicles can be purchased a few at a time each year, maintaining an average age of fleet of three to

four years, while at the same time maintaining a predictable level of variable maintenance expenses.

- Today there is a choice in automated collection vehicles and a phased-in approach allows the City the opportunity to test and experiment with different units on a smaller scale, rather than an initial commitment to one style, make, or model. The industry is working to develop options to address the higher operating costs of automation while still maintaining the gains in efficiencies. These new technologies should be examined through pilot scenarios to maximize the cost savings benefit on automation.

- A significant portion of program capital and the system's most noticeable feature are the containers. Carts can be purchased or leased from container manufacturers who can also provide the maintenance services required. Each supplier offers a different level of specifications that should be considered, including subsequent repair and maintenance.

  Although most cart suppliers offer a ten year warranty on manufacturer defects, all cart systems require a level of service to deliver, remove, and regularly repair carts that become damaged during day to day operations. In many cases, containers can be procured with and without a service maintenance program. If the cart company is not conducting the service, City staff will be required to maintain the cart system, and once fully implemented will require full time staffing. When procuring containers, the city should consider requests for pricing that include both cart purchases and a separate price for cart maintenance services in order to properly evaluate the cost associated with this service. Additionally, today's economic climate has resulted in very low interest rates that the City could leverage when making new equipment and container purchases.

- Conversions should begin in newly planned subdivisions. Newly planned subdivisions are designed with adequate turning radii and street width, and sufficient amounts of off street parking, which are conducive to automated collection systems. Conversions in these newer neighborhoods can occur quickly such that:

  - Adding contiguous subdivisions (of acceptable route size) to the first area maintains route density, enhances production, and assists with planning new equipment purchases.

  - Equipment is purchased in stages as new areas are developed.

  - Education programs are introduced 3 to 6 months in advance of equipment delivery, and can be accelerated as a greater percentage of the City is converted.

  - Older neighborhoods are added to the program last.

**Manpower:**

As staffing and personnel costs represent the largest portion of savings in an automated conversion, there are a number of issues that should be addressed by the City during the planning phase. In Lakeland's case, an automated conversion implementation plan was estimated to reduce the Division staffing levels for residential waste collection from 58 to 32 positions, 23 of which are solid waste collectors.

In our experiences with similar municipal programs, automation provides significant opportunities for current solid waste employees to cross-train and advance in the Division. Further, automation preserves the City's aging workforce by reducing physical labor requirements for waste collection.

Nonetheless, these new collection vehicles will have enhanced technology requiring specialized training for technicians in the Fleet Management Division. Although this can present a challenge, it also can provide opportunities for current Fleet Division employees to cross-train and advance in the division with advanced technical certifications.

Deploying the new automated program in a phased-in approach will allow the City to plan for staff reductions through attrition: In this way, retiring employees, or those lost through normal attrition, are replaced with temporary staffing until which time the conversion to automation reduces staffing permanently. Although this sounds daunting, normal turnover in solid waste hauling operations can range between 10 and 20 percent annually.