

Key Performance Indicators in Waste Collections Routing

Overview

- Monitoring Key Performance Indicators in Collections Improves Your Ability to Manage and Route Operations as they Grow
- Goal of this presentation
 - Learn how you monitor performance
 - Review KPIs and best practices that have been found to be useful in waste collection routing

Background About Presenter

- Career geek:
 - Founder and former CTO of route optimization software company, C2Logix
 - President of TESSA Marketing & Technology implementing and developing software and mobile workforce technologies
- Over 60 route optimization projects in over 20 years all over the USA from San Francisco to Miami, New York City to LA
- Developed federal government's nationwide disaster response software for the Strategic National Stockpile
- Lessons Learned – Collections operations typically do not have easy access to KPIs for managing operations

What is a KPI?

- Key Performance Indicator
- A measurable value that demonstrates the effectiveness and efficiency of collection operations
- What it is not – KPIs are not always comparable across different operations.
 - One City may have geographic, population, facility locations or other issues that another City does not have the same issues.
 - They are just an “Indicator” to identify potential issues to investigate further.

Useful KPIs for Waste Routing

1. **Max Dumps** - Maximum number of dumps per day
2. **Packout Ratio** - Percent of dumped weight divided by maximum packout weight.
3. **Service Time** – Total route time minus time for depot/disposal travel, dumps, breaks and inspections.
4. **Workday Utilization**– Percent of the workday utilized doing the route divided by the scheduled hours in the day.
5. **Route Balance** – Range between the minimum and maximum route times in a day.
6. **Collection Day Balance** – Range between the minimum and maximum cumulative times for all routes in a day.
7. **Units per Day** – Stops or carts planned to be collected per route.
8. **Units per Dump** - Stops or carts collected for each disposal trip.
9. **Pounds per Stop** – Average weight of all stops in a route (not just those collected).
10. **Miles per Day** - Average miles driven in a route.
11. **Setout Rate** – Percent of units collected versus units planned to be collected.
12. **Productivity Rate** – Units collected divided by Service Time.
13. **Growth Rate** – Number of new units added per year.

What KPIs Do You Use When Evaluating Routes?

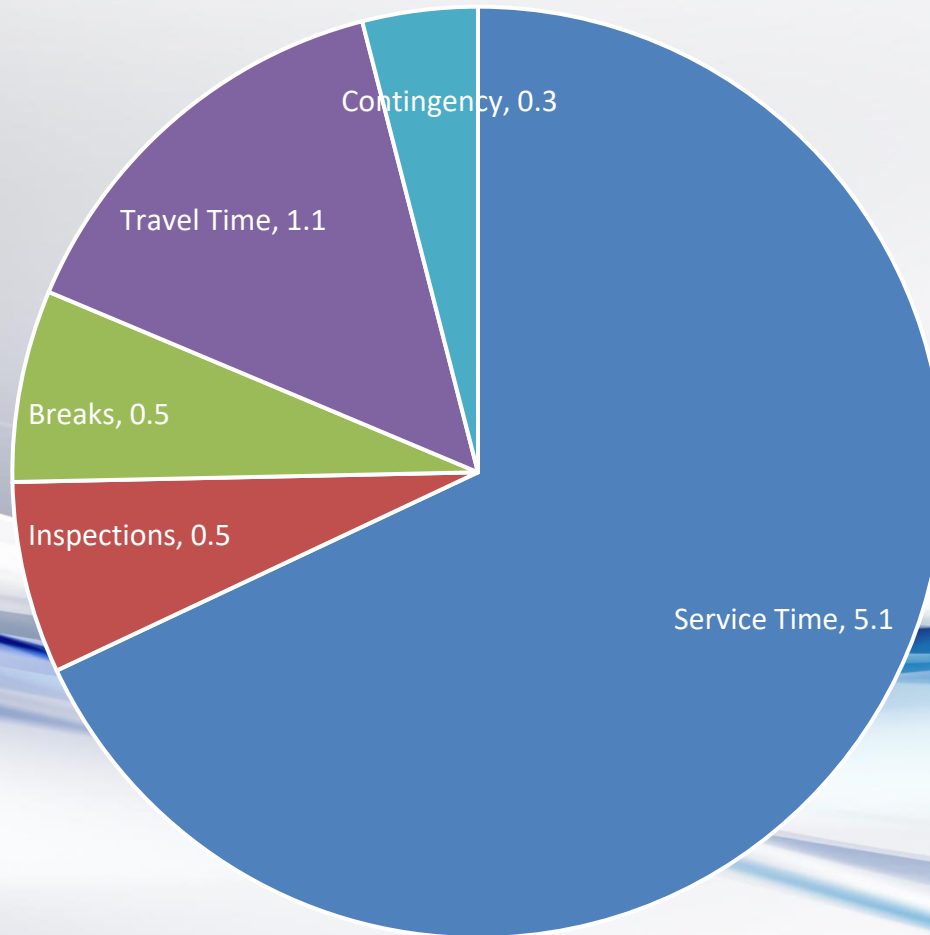
- How many use stop counts?
- How many use tons?
- Even fundamental data like tons and stop counts can be hard to access by operations managers on demand.

Order of Importance for Route KPIs

1. Time – Hard Limit – The 8 or 10 hour day is the overriding limitation.
2. Max Dumps – Hard Limit – That 8 or 10 hour day can't get more than 2 or 3 dumps.
3. Stops – Variable, depends on weights and distances between stops. Not a hard limit for automated, but is for semi and manual due to labor effort.

Route Day Pie

8 Hour Day



Routing KPI: Service Time

Service Time – Time used for only collecting customers and driving between customers, excluding facility travel, dump, breaks, and inspections.

Total route time **minus:**

- Travel to/from disposal
 - Travel to/from depot
 - Dump wait times
 - Pre-trip and post-trip inspection times
 - Break times
 - Lunch time
- **Example:** In an 8 hour route day, 4.1 hours is Service Time, 3.4 hours is facility travel, breaks, and inspections, 0.5 hours is unused time.
 - **Analysis:** With a Service Time of 4.1 hours versus 3.4 hours being used for facility travel, breaks, and inspections, the ability for making the routes larger to be a full 8 hours is limited. This indicates that there is a significant amount of facility travel and break time. The landfill is 10.6 to 25.8 miles from each route. It is also noted that the City provides a paid 30-minute lunch break, which is not common.
 - **Best Practice:** Maximize the availability of Service Time by minimizing inspection, travel times.

Routing KPI: Max Dumps

Max Dumps - Maximum number of dumps per day

- **Example:** With an average 1.9 dumps per day, the trucks are almost at the maximum of 2 dumps per day.
- **Analysis:** Often dumps are the limiting factor to increasing workload on a route.
- Going from 1 to 2 dumps requires adding ~400 stops...not a nominal change.
- If the dump is far away (e.g., more than 100 mile) you may not be able to have an additional dump and the route may be an hour or so light.
- If you maximize the dumps, you are typically maximizing productivity.
- **Best Practice:** Maximum of 2 dumps in an 8 hour day or 3 dumps in a 10 hour day

Routing KPI: Packout Ratio

Packout Ratio – Percent of dumped weight divided by maximum packout weight.

- **Example:** At an average of 6.9 tons per dump and a maximum pack out of 9.5 tons, the capacity utilization ratio is at 73%.
- **Analysis:** Truck capacity is not fully utilized leaving limited availability for efficiency improvements.
- Reaching maximum capacity is not practical with fluctuating set-out weights
- Maximizing the packout ratio requires distributing the customers with longer travel times across multiple routes, since it is the long haul routes that do not have enough time in the day to pack out the truck.
 - Beware that this may cause inefficiencies by running trucks to more distant customers that more efficiently be collected by a nearby route.
- **Best Practice:** 85% - 90%.

Routing KPI: Workday Utilization

Workday Utilization – Hours in the workday actually utilized to complete the route divided by the scheduled hours in the day.

- **Example:** With an average of 7 hours per route or 88% of the day utilized, the workday leaves limited slack for increasing the workload to a full 8 hours.
- **Analysis:** Targeting a full 8 hour route day could lead to overtime during anomalous days, which would be expected given breakdowns, weather events, fluctuations in set-out weights and rates, and variances in the performance of operators.
- **Best Practice:** Target route times to be 30 minutes light (94% in an 8 hour day).

Routing KPI: Route Balance

Route Balance – Range between the minimum and maximum route times in a day.

- **Example:** The range of carts per route going from 792 to 1112 and time ranging from 6.2 hours to 7.8 hours indicates unequitable routes and a poor route balance.
- **Analysis:** By improving the evenness of the routes to be within a range of plus or minus 15-minutes will improve the overall efficiency and productivity of the system.
- Light routes typically have a lower productivity rate, as they tend to be completed in times close to other heavier routes.
- Making all routes reduces squabbling amongst the crews and makes it easier for substitutes.
- Route areas with terrain ranging from rural to urban are difficult to make time balanced and stop counts balanced.
- **Best Practice:** Target route times to be within 30 minutes of each other route, while trying to keep the units collected within 150 of each other. Balanced on time is more important than balanced on stop counts, unless it is manual collection and the physical exertion of helpers must also be considered making stop counts equally important.

Routing KPI: Collection Day Balance

Collection Day Balance – Range between the minimum and maximum cumulative times for all routes in a day.

- **Example:** Total hours per collection day ranges from 43 hours on Tuesday to 51 hours on Monday to complete the routes, which is a 20% variance.
- **Analysis:** Combined with growth of 400 homes per year, the imbalance between collection days indicates that this is an increasing problem.
- Without balancing the days, overtime or running an unequal number of trucks per day is inevitable...just as inevitable as the operators complaining about heavy routes!
- **Best Practice:** Maintain total times per collection day to be within no more than 1 routes worth of customers. If the average route is 8 hours, then the days should be adjusted once one day requires an additional truck.
 - If Monday takes a combined 51 hours with the “all days” average of 48 hours, incremental day changes should be made when Monday hits 56 hours allowing for a smaller 800 homes to change now versus waiting for 1,000s later.
 - Rarely followed due to anxiety of impacting customers by City management, politicians, customer service, and crews.
 - In reality, collection day changes are typically uneventful, especially when done for a small number of customer at a time.

Routing KPI: Units per Day

Units per Day – Stops or carts planned to be collected per route.

- **Example:** Alice's automated side loader route has 1,010 stops, but Bob's route has 820 and takes the same amount of time.
- **Analysis:** If Bob does not have a reason for the lower productivity (mileage, weights, alleys), he may need training or the routes need to be rebalanced
- **Best Practice:** Routes typically are considered efficient with the following counts of carts (or stops for manual) collected.

Collection Type	8 Hour Day	10 Hour Day
Automated Side Load	800 – 1,000	1,000 – 1,200
Semi-automated Rear Load	700 – 900	800 – 1,000
Manual Rear Load (1 helper)	600 – 800	700 - 900

- There are numerous exceptions such as, abnormally high or low set-out weights, distances to disposal exceeding 15 miles, total route miles exceeding 100 miles, dump wait times exceeding 20 minutes, alleys or other maneuver restrictions.

Routing KPI: Units per Dump

Units per Dump - Stops or carts collected for each disposal trip.

- **Example:** Alice collects 550 carts before dumping, but Bob collects 420 carts and takes the same amount of time.
- **Analysis:** Using the same ASL truck, Bob's lower count is actually typical for an automated route dump collecting home generating 50 lbs a week. Alice's route looks like the set-out weights are abnormally low, maybe due to smaller homes or neighborhoods with less young families and with less residents per home. If Bob's counts were under 400, it may be useful to look at the Packout ratio to see if Bob is dumping early.
- **Best Practice:** Units per Dump is useful when evaluating route changes. One dump, which is a half day route, should be the lowest increment used to create a route. A whole route, typically two dumps is the next largest increment.

Routing KPI: Setout Rate

Setout Rate – Percent of units collected versus units planned to be collected on each collection day.

- **Example:** Alice's recycling route collects 900 of her 1,800 stops (50% set-out rate), but Bob collects just 450 of his 1,800 stops (25% set-out rate).
- **Analysis:** Bob and Alice's routes are not balanced.
- Setout rate is different than the participation rate, which is used to assess the percent of customers that are collected in a given month (versus on each given day used for set-out rate).
- **Best Practice:** For recycling routing, set-out rate is critical. Recycling routes must be based on the actual number of set-outs and not the planned number of homes to drive by.
- Obtaining accurate set-out rates is problematic. Arm pull counters or clickers can be used.

Routing KPI: Productivity Rate

Productivity Rate – Units collected divided by Service Time. Seconds per stop is interchangeable.

- **Example:** The Carts Per Hour In-service averages 194 with a range of 171 to 231.
- **Analysis:** 194 carts per hour is right within the performance of an efficient automated collection of 180 to 220 units per route day.
- **Best Practice:** A typical range of an efficient route will be between 180-220 carts per hour for automated collection.
- Driving time between customers can greatly impact the Productivity Rate.
- More rural areas will be below 180 per hour.

Routing KPI:

Issues With Time-based KPIs

- **Breaks skew times**
 - Do they take a break or not? When calculating route times from scale tickets or route logs, we never know if breaks or taken during the route or after. Typically, they are taken after the route, but are removed from the service time, which skews the productivity rate to be higher than actual.
- **The myth of the 30 seconds per stop rule**
 - Equal to 120 stops an hour, this variable can be accurate for manual or semi-automated collection, but is a different calculation as facility travel time and breaks are typically not removed.
- **Manual and Semi-automated collection Varies based on Helper Count and Route Paths**
 - A 2 helper semi route can equal the speed of automated.
 - A poorly run 2 helper route can be as slow a one helper route if dispersing helpers too far to retrieve carts

Routing KPI: Growth Rate

Growth Rate – Number of new units added per year.

- **Example:** The City is adding 2,000 homes per year, all of which are getting carts.
- **Analysis:** In essence, the City is adding two (day) routes per year, since it has automated collection averaging 1,000 carts per route. In two years, a new truck will need to be added.
- **Best Practice:** Plan for expanding routes at pace with the growth in single family housing by never letting the new homes exceed one truck's worth of workload. In the above example, never let the new stops exceed 5,000 before minor re-routing.
- If the operation is smaller with less than 6 trucks, a new truck should be added when there are two route days worth of new customers, in order to avoid overtime.

How Do We Get Those KPIs?

- Extract them from route logs or scale tickets
- Scale tickets cross referenced with the route ID and truck number can be summarized by day:
 - Average time to first and last dump
 - Average tons at first and last dump
 - Average dumps per day
- Record Your Route Number at the Scale!
 - Much easier to generate route level statistics

Thank You

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