KING COUNTY

Signature Report

Motion 15280

Proposed No. 2018-0550.1   **Sponsors** Balducci

1   A MOTION related to public transportation;

2   acknowledging receipt of a report on updating on-

3   time performance measures to incorporate

4   cancellations of trips, as required by the 2017-2018

5   Biennial Budget Ordinance, Ordinance 18409,

6   Section 115, as amended by Ordinance 18766,

7   Section 52, Proviso P4.

8   WHEREAS, the 2017-2018 Biennial Budget Ordinance, Ordinance 18409,

9   Section 115, as amended by Ordinance 18766, Section 52, appropriated monies to the

10   public transportation fund and included proviso P4, requiring the executive to transmit a

11   report describing a plan to update on-time performance measures to incorporate

12   cancellations of trips, receipt of which is to be acknowledged by the council by motion,

13   and

14   WHEREAS, King County Metro staff has compiled the required information as

15   set forth in the Updating On-time Performance Measures to Incorporate Cancellations of

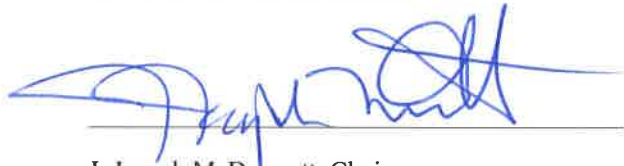16   Trips report set forth as Attachment A to this motion;

17   NOW, THEREFORE, BE IT MOVED by the Council of King County:

18   The council hereby acknowledges receipt of the Updating On-time Performance

19   Measures to Incorporate Cancellations of Trips report, Attachment A to this motion.

20

Motion 15280 was introduced on 11/13/2018 and passed by the Metropolitan King County Council on 12/10/2018, by the following vote:

        Yes: 9 - Mr. von Reichbauer, Mr. Gossett, Ms. Lambert, Mr. Dunn, Mr. McDermott, Mr. Dembowski, Mr. Upthegrove, Ms. Kohl-Welles and Ms. Balducci
        No: 0
        Excused: 0

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON

J. Joseph McDermott, Chair

ATTEST:

Melani Pedroza, Clerk of the Council

Attachments: A. Updating On-time Performance Measures to Incorporate Cancellations of Trips

King County Metro Transit

Ordinance 18766 Proviso P4 Report

Updating On-time Performance Measures to Incorporate Cancellations of Trips

October 31, 2018

Prepared for:
King County Council

Prepared by:

**King County
METRO**

**Department of Transportation
Metro Transit Division
Strategy & Performance**
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Alternative Formats Available
206-477-3832   TTY Relay: 711

Introduction

Ordinance 18766, Section 52, which adopted a supplemental appropriation to the 2017/2018 King County Biennial Budget included Proviso P4 that states:

P4 PROVIDED FURTHER THAT:

Of this appropriation $100,000 shall not be expended or encumbered until the executive transmits a report describing a plan to update the on-time performance measures to incorporate cancellations of trips and a motion that should acknowledge receipt of the report, and a motion is passed by the council.

In accordance with the proviso, this report shall

1. Describe current on-time performance and trip cancellation measures and methodologies for calculating the measures.
2. Provide a revised description of on-time performance measures that incorporates cancellation of trips as an element of on-time performance and methodologies for calculating the measures.
3. Describe measures Metro takes to address (1) routes with more late trips than the thresholds established by the King County Metro Service Guidelines; and (2) routes that experience cancellations that exceed Metro target rates.
4. Present options for potential changes to the King County Metro Service Guidelines to prioritize investments in routes that exceed a thirty-percent all-day late threshold.
5. Present a timeline for implementing the revised on-time performance measures.

Scope

This report focuses on non-RapidRide, fixed-route service. RapidRide is excluded, as its reliability is measured in terms of adhering to scheduled headways (i.e. time between buses), which is fundamentally different from standard on-time performance measurement.

A. Current Processes

On-time Performance Measures

At its simplest, on-time performance compares actual bus performance to bus schedules. While the ultimate purpose of measuring on-time performance is to ensure quality of service for customers, the primary use of on-time performance data is to identify resources needed to build realistic schedules for buses that best reflect actual bus travel times.

Many factors affect on-time performance. Generally, the following factors are under Metro's direct control:

- Adjusting schedules to better align with average travel times (as resources allow)
- Ensuring buses leave bases on time

Some factors involve daily variability:

- General traffic conditions
- Variations in ridership (affecting the time it takes to load/unload passengers)
- Passengers loading bikes on bike racks
- Assisting people with disabilities
- Short-term incident reroutes (accidents, emergencies, protests, etc.)

Other factors require action and/or investment on the part of jurisdictions to improve, and often involve partnerships between Metro and jurisdictions. These include:

- Longer-term construction reroutes
- The existence of transit-supportive infrastructure, including HOV and bus lanes, queue jumps, and transit signal priority

Metro schedulers create bus schedules in a system called HASTUS. Actual bus performance data is captured by systems on each bus, collectively referred to as the Automatic Vehicle Locator system (AVL). Data from both HASTUS and AVL is collected in a single database so comparisons can be made.

Schedulers build bus schedules with reference points called "time stops." Time stops are tied to select physical bus stops along routes, but not every bus stop is a time stop. Comparisons between scheduled and actual arrivals are made only at time stops.

- Buses that arrive at time stops up to 1.5 minutes before the scheduled time and up to 5.5 minutes after the scheduled time are considered to be on time and within the window of acceptable service to our customers. This allows for expected variations resulting from operating with varying passenger loads, serving customers of varying abilities, accommodating bicycle loading and other minor delays, and competing for road space with other traffic to occur without prompting an unnecessary allocation of resources.
- Buses that arrive at time stops that are between 5.5 and 20.5 minutes behind schedule are internally classified as "late-low", and arrivals at time stops that are between 20.5 and 30.5 minutes behind schedule are internally classified as "late-high". For external reporting purposes, "late-low" and "late-high" are combined and are simply called "late."

- Buses that arrive at time stops that are between 1.5 and 5.5 minutes ahead of schedule are internally classified as "early-low", and arrivals at time stops that are between 5.5 and 10.5 minutes ahead of schedule are internally classified as "early-high". Metro does not typically report early arrival information externally. Metro drivers are not allowed to *depart* time stops early (with minor exceptions; see next bullet) and are instructed to attempt not to *arrive* early. Early arrival data is used to assist schedulers in adjusting schedules to more accurately reflect actual travel times.
- In addition to regular time stops, Metro employs a system of "estimated" time stops. This type of time stop is typically located at or near the end of a route that travels on a highway and makes only a few stops at the end of its route, like many of our commuter routes. For these estimated time stops, early arrivals do not represent a negative impact to customers and are therefore counted as on-time. However, late arrivals, which <u>do</u> represent a negative impact to customers, are still counted as late.
- Bus arrivals at time stops outside the windows defined above (e.g. more than 10.5 minutes early or more than 30.5 minutes late) are excluded from on-time performance reporting. These instances reflect abnormal and rare operating conditions, including snowstorms, extremely bad traffic, and other incidents that cause severe disruptions to transit service. This data is not useful in building accurate schedules. Including this data would skew the results of on-time performance reporting and could result in unnecessary inefficiency in the system.

On-time performance data is collected and processed daily. The process involves collecting each bus arrival at a time stop, comparing it to the schedule, and classifying each according to the schema outlined above.
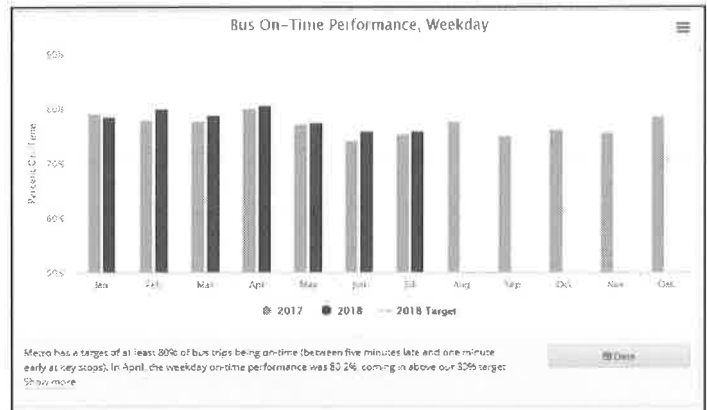
- On-time performance equals the number of on-time arrivals divided by the total number of arrivals recorded.
- Lateness equals the number of late-low and late-high arrivals divided by the total number of arrivals recorded.
- Earliness equals the number of early-low and early-high arrivals divided by the total number of arrivals recorded.

Standards

Metro has an informal system-wide on-time performance target of 80 percent on-time. By policy (as set forth in the Service Guidelines), no route should be more than 20 percent late all-day, and no more than 35 percent late in the PM peak period (3-7 pm). These thresholds prompt the identification of reliability investment needs in accordance with the Service Guidelines (also known as Priority 2 investments).

On-time Performance Reporting and Uses

On-time performance data is typically summarized and analyzed on both a monthly basis and a service-change basis (i.e. an entire service change's worth of data). Monthly reporting is used internally at monthly business reviews to track both performance and the effectiveness of our previous investments targeting improved reliability. This data is also reported externally via our online Accountability Center.

On-time Performance in the Accountability Center

Service change on-time performance statistics are reported in the Strategic Plan Progress Report and the annual System Evaluation. For the System Evaluation, late arrivals are analyzed by route and by time period. Four time periods are analyzed: weekdays all day, weekday PM peak, Saturdays all day, and Sundays all day. For each route and each time period, the percentage of late arrivals is calculated. For all-day measures, routes that arrive late more than 20 percent of the time are identified for investment. For the weekday PM peak period, routes that arrive late more than 35 percent of the time are identified for investment. Initial investment needs are formulaically estimated based on the magnitude of lateness observed and the size of the route (in service hours). Schedulers then use this information to conduct detailed analyses, identify feasible actions, and modify schedules within available resources.
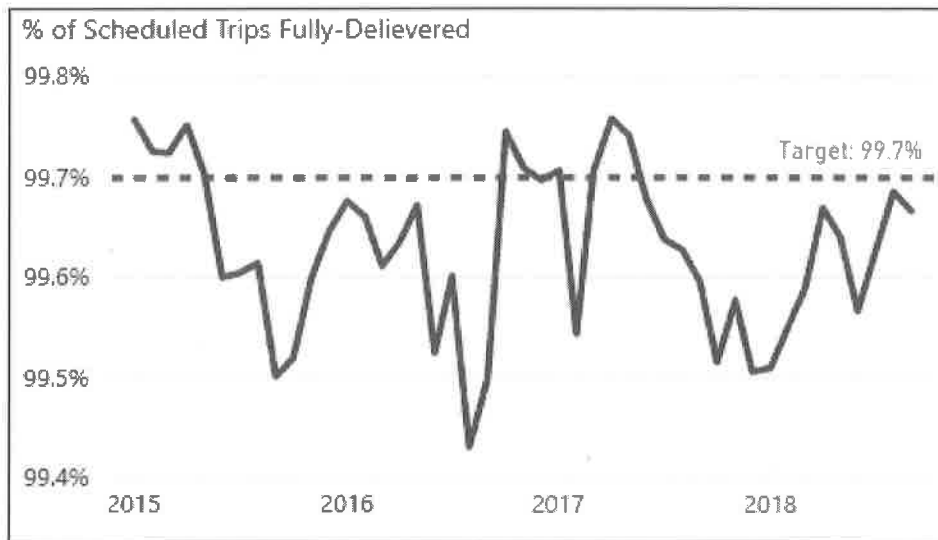
Schedulers use on-time performance data on a regular basis to evaluate and manage the bus system. They routinely consult several months' worth of unsummarized daily information to arrive at "best fit" travel times. This unsummarized data produces scatterplots of each bus' travel time between two time points, overlaid on the current scheduled travel time. Schedulers then use tools to find the optimal amount of time to allow between each set of time points they analyze so that, to the extent possible, more buses will arrive on-time. Sometimes, scheduled travel times can be shortened, but in times of increasing congestion, travel time usually needs to be lengthened. Increased variability in travel times also pushes the schedulers to add more layover time between service trips to improve the "resiliency" of Metro's schedules so that later trips in a driver's workday can start on time. In many cases, additional coaches and operators are required when time is added to schedules, so this exercise is often restricted by available budget and other resources.

Metro's Speed & Reliability group uses on-time performance data and other analyses of AVL data to identify corridor improvements to help keep buses moving. This information is critical in identifying where to make capital improvements in transit corridors. Staff use this data to help pinpoint specific places where buses typically experience delays. Surveys and additional analyses help determine the causes of these delays, and Metro works closely with local jurisdictions to develop and implement solutions.

Trip Delivery/Cancellations

Data on the percent of fully-delivered trips is presented in the digram below. Following a spike in trip cancellations in 2015, Metro devised several ways to routinely track and monitor cancellations in 2016 and began implementing various improvement measures in late 2016 and through 2017 and 2018. The spike was largely due to a hiring freeze in 2014 prompted by looming service cuts and a subsequent unanticipated rapid service growth and expanded need for new drivers.

As part of the monthly business review process, Metro established an interim target of fully delivering 99.7% of scheduled trips (system-wide) as a method to drive problem-solving efforts. No route-specific target has been set, due to the reasons outlined above. From 2016 to the present, Metro has fully delivered an estimated 99.62% of scheduled trips. This rises to an estimated 99.68% when excluding trips that were curtailed due to extreme lateness.[1]
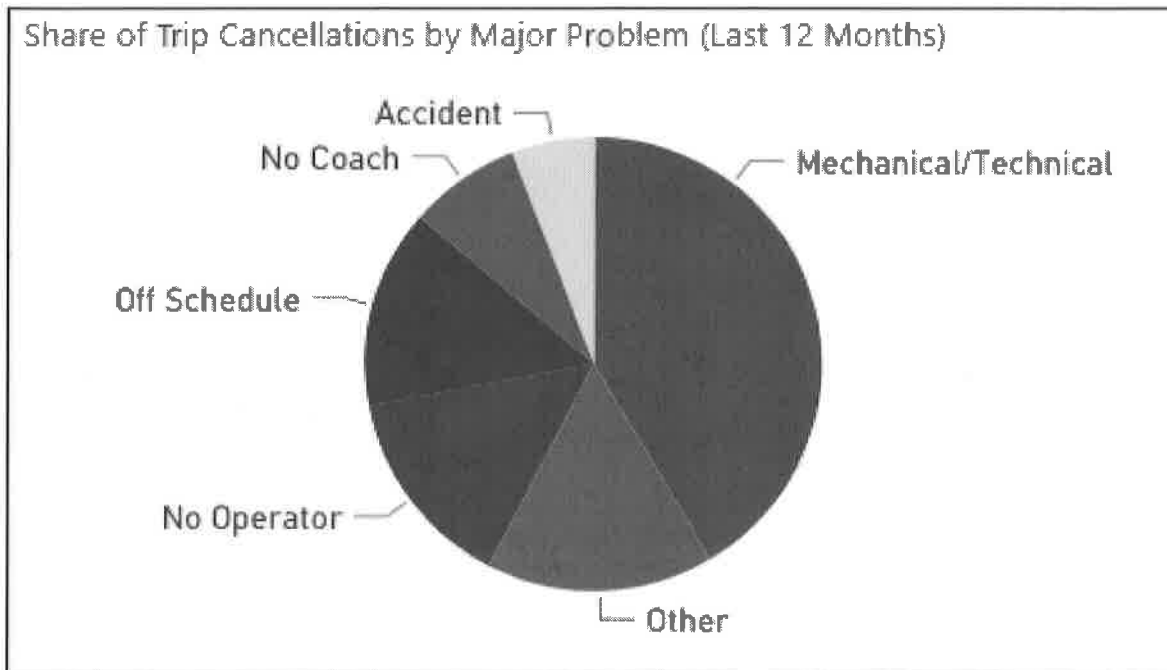

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[1] Missing trips due to extreme lateness occurs most often on frequent routes, including routes 3, 5, 36, and 70. When a bus is extremely late, and if another is behind it, the control center may "express" the late bus past normal stops so it can get back on schedule, if the situation permits. (Drivers will still let passengers off at requested stops.) When this occurs, we count it as a missed trip. Separately, we have identified data quality and processing issues that appear to result in a significant over-estimation of the number of trips missed due to extreme lateness.

The first improvement process implemented focused on AM and PM peak cancellations of entire vehicle blocks (i.e., a bus that was supposed to leave a base never did) due to the unavailability of either a coach or a driver. As cancellations became more frequent, this process enabled Metro to manage cancellations in a stop-gap way by ensuring the negative impacts were distributed across the county, as opposed to cancelling the same routes and runs day after day. This practice continues today.

The second, more strategic improvement process tapped into a record of problems encountered in delivering bus service. This record, called the Coordinator Service Record (CSR) log, is manually populated by bus service communications coordinators at the Transit Control Center and records disruptions to service, including cancellations. The use of this data to track trip cancellations is novel and is not the intended or designed use of the data. However, it does provide reasonable, but not wholly comprehensive, data to help drive system-wide problem-solving efforts. Tracking this information is part of our monthly business review at the agency level. The Operations and Vehicle Maintenance sections are also tracking cancellation causes specific to their functional work areas and taking actions (details below).

The key piece of information in this log that is contained nowhere else is an indication of *why* a particular trip was cancelled or not fully delivered. Data processing uses a set of pre-defined "problem codes" in the CSR data to assign causes to each cancellation. These include everything that can cause a bus to not begin a trip or to be unable to complete a trip. Reasons range from coach and operator unavailability, to breakdowns on the road, to security incidents. We estimate the number of trips that were either cancelled or not fully-delivered (i.e., something happened mid-trip that precluded the bus from completing its trip), and then group the cancellations by these problem codes, bus base, day of week, and time period. Such information at a system level for 2017 is presented below.

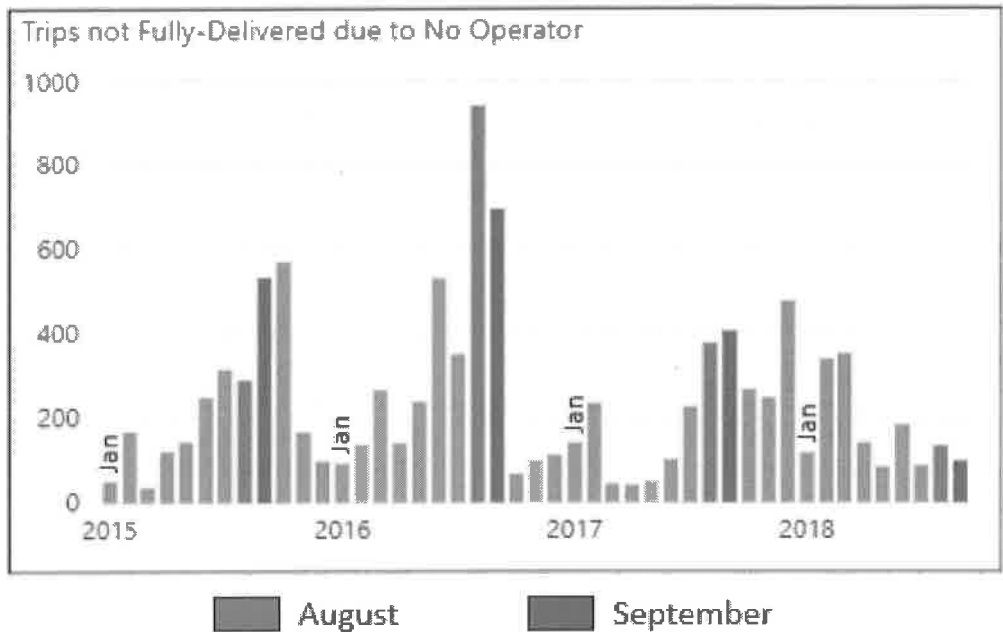**Share of Trip Cancellations by Major Problem (Last 12 Months)**

We avoid analyzing data by service route for several reasons:

- While we can track reasons for cancellations over time, trip cancellations due to a specific reason occur mostly randomly across routes. Solutions for the most prevalent problems will not be route-specific.
  - Some routes may experience problems more consistently than others, but we find that the major problems contributing to trip cancellations are, at best, base-specific. For instance, if a particular base is having driver staffing issues, trip cancellations due to operator unavailability will be high at that base and high on routes operating out of that base, but the problem is not route-specific. Solutions would therefore not be route-specific.
  - Cancellations due to coach unavailability and mechanical breakdowns on the road are not tied to any specific route, but patterns may manifest at the base or system level.
- The CSR log does not contain comprehensive service route information. Instead, it tracks issues by vehicle block route. In a single assignment, one bus may operate on multiple service routes (e.g., Route 5 southbound turns into Route 21 when it reaches downtown Seattle), so it can be difficult to ascertain the service route on which any particular issue occurred.

In 2015 and 2016, Metro identified significant trip cancellations due to driver unavailability, and therefore focused process improvements in this area. Since instituting problem-solving efforts around driver staffing, Metro has seen improvement in the number of cancellations due to operator unavailability. Problem-solving efforts concentrated on streamlining and hastening operator hiring, conducting more training classes, and staffing

the driver "extra board"[2] at a healthy level. Summer spikes seen in 2015 and 2016 have been reduced, and the data is showing promising signs of cancellations associated with driver availability being significantly reduced in the second half of this calendar year. Trip cancellations resulting from a lack of drivers dropped 82% from our high in August 2016 (892 estimated cancelled trips) to August 2018 (157 estimated cancelled trips). Similarly, September 2018 saw 80% fewer trip cancellations due to a lack of drivers than September 2016.

Metro also detected a spike in cancellations due to coach unavailability earlier this year. It should be noted that many of the trips that are initially canceled due to coach unavailability are filled by other drivers finishing their regular assignment, or by standby coaches. Changes to mechanic staffing and the day-to-day management of the fleet have significantly reduced these cancellations. For example, efficiencies and adjustments to mechanic staffing on weekends (which have many fewer buses in service) have allowed for larger repairs to be completed in a more timely manner and has better enabled mechanics to fulfill maintenance requirements on coaches that were unavailable for maintenance during weekdays. This has improved coach availability early in the week, which is when many coach availability issues were noted.

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[2] The "extra board" is an established set of full time drivers who can take on "vacant' work (i.e., work that currently has no assigned driver for the day). This work can either be "un-picked" work (i.e. the work that regularly has no assigned driver) or work that becomes "vacant" due to vacation, illness, or other unplanned event. Our analysis indicated that the size of the extra board was initially reduced in response to a previous performance audit and then continued to shrink as Metro's service growth from 2014 through 2017 outpaced operator hiring. Over the past year, Metro has been able to recover and reach a point where the extra board is more properly/fully staffed.

Metro is also in the early stages of problem-solving and devising solutions to cancellations resulting from mechanical breakdowns on the road. This is a longstanding issue that will require multiple lines of effort to improve. As a first step, Metro is piloting pre-staging a maintenance truck in the field to respond to mechanical breakdowns faster and get buses back into service. Metro is requesting funding for an additional truck to expand the scope of this effort.

B. Potential Revisions to Measures

As previously mentioned, our current measurement of trip delivery is based on manually-entered information. CSR logs are subjected to minimal quality control processes due to limited staffing at the Transit Control Center (TCC). Metro is looking to improve this situation in several ways, an effort that will likely take one to two years to accomplish:

- Increasing staffing at the control center to produce a more robust stream of data on trip cancellations. Additional staffing is proposed in Metro's '19-'20 budget proposal.
- Using AVL and schedule information to establish a "ground truth" of which trips were canceled or not fully delivered. This method, once developed, should provide a more accurate information source that is also automated.
- Tying CSR information to machine-produced data, including AVL and vehicle dispatch data, in a rules-based, standardized, and auditable way.

Additionally, Metro is planning a technology solution to automate app-based customer notifications of canceled trips. This solution will automatically update our real-time transit feed (which is used by third-party apps like OneBusAway) when TCC staff cancel service. When trips are canceled, customers will see those trips as canceled in the app, whereas currently, schedule information is displayed. Customer Communications and Services will still send out alerts as they do now.

Metro welcomes adding a measure of trip delivery / missed trips under a "reliability" umbrella, once such a measure is fully developed. Metro recognizes the impact of missed trips on the customer experience and the importance of tracking them and developing solutions to reduce them. However, Metro does not recommend *combining* current on-time performance and trip delivery metrics into a single metric for the following reasons:

- While both metrics are related to reliability, they measure fundamentally different things and are used for different purposes. The on-time performance of a trip that does not run simply does not exist, or is infinitely late.

- Similar to why extreme lateness is excluded from our measurement of on-time performance, missed trips are generally random and sporadic across routes. Including them in a revised measure of on-time performance could skew data used to build schedules.
- Solutions to improve on-time performance can be route-specific, while solutions for missed trips are either system-wide or base-specific.
- Solutions for on-time performance deficiencies and missed trips take different forms:
  - On-time performance is improved by revising schedules (adjusting to changing traffic and ridership conditions) and making capital and operating improvements to keep buses moving through traffic. These solutions will not affect the number of missed trips, except for potentially a small number caused by extreme lateness.
  - Solutions for reducing missed trips have and will continue to take a variety of other forms. Currently, these solutions include added staffing and management of operator and vehicle maintenance personnel and processes and changes to how we manage the fleet on a day-to-day basis. In the future, solutions to solve other causes of missed trips will cut across the organization, but will remain fundamentally different from those used to improve on-time performance. For instance, reducing the number of breakdowns on the road (and their impact) would involve an intensive, long-term, multi-pronged effort and would not be specific to any route.

C. Countermeasures to Poor Performance

As noted above, on-time performance for routes that exceed the thresholds established by the Service Guidelines is improved by revising schedules/adding service hours (adjusting to changing traffic and ridership conditions) and making capital and operating improvements to keep buses moving through traffic.

Also as noted above, solutions for reducing missed trips include added staffing and management of operator and vehicle maintenance personnel and processes and making changes to how we manage the fleet on a day-to-day basis. Improvement efforts in these areas are ongoing.

D. Potential to Prioritize Investments

The improvement processes described above are occurring in the context of other events and initiatives.

Reliability Audit. The King County Auditor is conducting an audit of Metro's reliability, including both on-time performance and missed trips. A report is expected in Q1 2019 that will detail our processes and how we respond to reliability issues. Metro will take the auditor's findings and recommendations into consideration when crafting a way forward for measuring and improving reliability.

Service Guidelines Updates. Metro will be collaborating with the King County Council, Regional Transit Committee, and stakeholders in 2019 to develop proposed policy changes to better align the Service Guidelines with METRO CONNECTS. It may be possible to include revisions to official reliability measurements and adjustments to how Metro should allocate resources based on those measurements would occur as part of this process, or it may be appropriate to include in a separate future update.

- A change to the Service Guidelines to prioritize for investment those routes that exceed a 30 percent (or other specified) lateness threshold could occur as part of this process. Metro would need to measure the likely future impacts of such a change, balance it against other potential prioritization factors (including but not limited to social equity, geographic value, and ridership), and vet the results of this analysis and the policy change through the stakeholder review process. It is important for Metro to maintain the ability to also address on-time performance on other unreliable routes.
- Adding a metric for missed trips could also occur as part of this process, given the constraints mentioned previously.

E. Timeline

The King County Auditor's report is expected in Q1 2019. This lines up well with the Service Guidelines update process and blends nicely with the intent of this proviso to call the question of implementing a new approach to measuring the reliability of our transit service. The magnitude and impact such a policy change would have on Metro's historical processes should not, however, be understated.

Prior to and since the Service Guidelines were instituted, Metro's primary method of improving on-time performance revolved around injecting additional time (service hours) into bus schedules. Service Guidelines policies, and the practices instituted at Metro to implement them, revolve around estimating a service hour investment level and then investing in routes accordingly. As time has passed, Metro has become acutely aware that this solution should not be the preferred solution in all cases, as it merely

acknowledges that buses are traveling more slowly and results in schedules that reflect this degradation of service. While it is important to communicate a realistic schedule to customers, this method of investing 1) does not actually improve travel times, 2) costs Metro more money in operational costs, and 3) does not add new service for our customers. Policies that direct funding to capital improvements and stronger partnerships with jurisdictions can and have resulted in actual improvements in travel times, producing benefits to customers and to Metro's bottom line.

Metro is already engaged in problem-solving efforts to reduce missed trips, driven by a monthly business review process and a growing culture of continuous improvement. However, incorporating a measure of missed trips into an expanded measurement of reliability and having policies that enable Metro to dedicate resources to reducing missed trips under the auspices of Priority 2 investments in the Service Guidelines could help Metro prioritize these efforts.

Such a change, along with added capital investments for on-time performance, would involve a partial shift away from the typical service-hour investment estimates for which the Service Guidelines currently call. Metro would need to integrate capital planning and resource estimates, as well as other problem-solving project estimates, into dollar-figure investment values. This would involve integrating additional staff work into the Service Guidelines process to an unprecedented extent. Additional initiative- and project-level resources would need to be dedicated to such an effort as well. In an ideal situation, these efforts would be initiated based on the results of periodic analyses; acquiring and allocating human and capital resources for these efforts mid-biennium could encounter difficulties, as our budget is set only once every two years.

Transforming the current approach to measuring missed trips into a more formal, data-rich, standardized, integrated, and auditable metric could likely occur over the course of the coming biennium, assuming the more technical data systems work required to do so is not extensive. Metro has not formally identified resources for all of this potential work.