American Public Transportation Association

Scheduling Practices Toolkit

Cutting-Edge Techniques to Optimize Operator Work Scheduling

American Public Transportation Association

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The Toolkit

Recruiting and retaining a skilled workforce is crucial for any transit agency. APTA's Transit Workforce Shortage Report highlights that the demanding schedules required of transit workers are a major factor driving them out of the industry. In response, some agencies have begun exploring ways to provide better schedules for their employees.

This toolkit, **developed from discussions with transit agencies and insights from a working group of stakeholders**, aims to guide agencies through an assessment of their scheduling practices and basic steps in developing strategies to enhance workforce scheduling processes and improve employee retention. It organizes the lessons learned from a working group of stakeholders guided by the objective of **addressing how to truly improve the quality of life for operators through innovative ways of designing schedules while focusing on the service that needs to be delivered**.

HOW TO USE THIS TOOLKIT

The toolkit begins with a self-assessment that connects scheduling issues with key aspects of scheduling identified by the working group. The self-assessment groups scheduling practices and issues under four key topics:

- **Building Better Schedules:** Identifying common challenges and pain points in current scheduling practices at your agency.
- **Creating Flexible Workdays or Hours:** Exploring options for more adaptable scheduling to meet the diverse needs of your workforce.
- **Improving Shift Assignment:** Analyzing methods for assigning shifts that balance operational requirements with employee preferences.
- **Communicating with the Workforce:** Emphasizing the importance of clear, consistent, and transparent communication regarding the scheduling at your agency.

To address these issues, we have organized strategies under four comprehensive areas:

- **Scheduling Techniques (S):** Innovative and practical methods to create more efficient and effective schedules.
- **Agency Culture and Morale Strategies (C):** Approaches to foster a positive work environment and enhance employee satisfaction and retention.
- **Planning Strategies (P):** Service planning approaches to ensure sustainable workforce schedule improvements.
- **Technology Solutions (T):** Leveraging modern technology to streamline scheduling processes and improve overall efficiency.

Each strategy category includes a set of suggested performance indicators that agencies can use to pursue solutions.

By focusing on these components and strategies, this toolkit aims to provide agencies with the tools and insights needed to enhance their scheduling practices, improve employee retention, and ultimately deliver better service outcomes.

Self-Assessment

Complete the **Self-Assessment Worksheet** following three steps:

1. **Understand Your Issues:** Read common scheduling-related issues faced by transit agencies.
2. **Understand Your Practices:** If a problem statement resonates with your agency's issues, note initial thoughts about reasons why the issue exists, what barriers or challenges are in addressing the issue, or any potential opportunities you identify along the way.
3. **Review Proven Strategies and Metrics:** Review the strategies identified in the third column: the letter and number combinations refer to specific strategies in the Strategies section.

Building Better Schedules

	1. UNDERSTAND YOUR WORK SCHEDULING ISSUES	2. UNDERSTAND AND TAKE NOTE OF YOUR PRACTICES	3. IF YOU'RE HAVING THIS ISSUE, SEE STRATEGIES LINKED BELOW
COMMON ISSUES	1. **SHORT NOTICE SCHEDULING** At my agency, **operators often receive their schedules with very short notice**, making it difficult for them to plan personal activities and manage their time effectively.	**Use this space to take note of your agency's practices, similar issues, or barriers within processes at your agency*	▪ T4: Implement Electronic Picking ▪ T3: Promote Employee Autonomy
	2. **UNREALIZED REST PERIODS** The schedules are designed to include adequate rest periods on paper, but in reality, due to delays and unexpected traffic conditions, **operators often find these breaks cut short or skipped entirely**.		▪ S1: Understand Your Runtimes ▪ P1: Ensure Adequate Layover Times ▪ P4: Streamline Bus Routing
	3. **EXCESSIVE OVERTIME** Some operators are consistently assigned **excessive or mandatory overtime**, leading to fatigue, burnout, and reduced job satisfaction.		▪ S3: Implement Integrated Scheduling for Runcutting ▪ C5: Improve Communication and Feedback Channels
	4. **SPLIT SHIFTS** **Many runs** at my agency **include split shifts** with long breaks between shifts, causing inefficiencies and longer workdays.		▪ S1: Understand Your Runtimes ▪ C4: Invest in Incentive Programs
	5. **LOW ON-TIME PERFORMANCE** Routes with high variability in **traffic conditions cause delays** and increase stress for the operators.		▪ S1: Understand Your Runtimes ▪ P1: Ensure Adequate Layover Times ▪ P2: Improve On-Time Performance
	6. UNDESIRED TRIPPERS We currently have a number of **open work or biddable trippers that**, due to their timing and structure, **cannot be combined into legal runs**. As a result, these trippers are frequently left for the extraboard, putting extra strain on our standby operators and leading to unpredictable workdays.	**Use this space to take note of your agency's practices, similar issues, or barriers within processes at your agency*	▪ S2: Understand Your Service ▪ S3: Implement Integrated Scheduling for Runcutting ▪ T2: Ensure Compliance

Building Better Schedules (cont.)

1. UNDERSTAND YOUR WORK SCHEDULING ISSUES		2. UNDERSTAND AND TAKE NOTE OF YOUR PRACTICES	3. IF YOU'RE HAVING THIS ISSUE, SEE STRATEGIES LINKED BELOW
COMMON ISSUES	7. **EXCESSIVE PAID GUARANTEE** We are seeing an **excessive amount of paid guarantee**, where operators are being compensated for time that isn't fully utilized due to gaps in their schedules. This is not only costly but also demoralizing for operators who feel their time is being wasted.	**Use this space to take note of your agency's practices, similar issues, or barriers within processes at your agency*	▪ S3: Implement Integrated Scheduling for Runcutting ▪ P3: Optimize Service Frequency and Span

Creating Flexible Workdays or Hours

1. UNDERSTAND YOUR ISSUES RELATED TO FLEXIBLE WORKDAYS OR HOURS		2. UNDERSTAND AND TAKE NOTE OF YOUR PRACTICES	3. IF YOU'RE HAVING THIS ISSUE, SEE STRATEGIES LINKED BELOW
COMMON ISSUES	8. **PART-TIME SHIFTS** **Operators** at my agency **are interested in part-time shifts** for to better manage their work-life balance.	**Use this space to take note of your agency's practices, similar issues, or barriers within processes at your agency*	▪ C5: Improve Communication and Feedback Channels ▪ T1: Develop Scenarios
	9. **CONDENSED WORKWEEKS** We are exploring the option of allowing **operators to work longer shifts over fewer days**, which would provide them with more full days off each week.		▪ T1: Develop Scenarios ▪ C1: Engage with Staff at all Levels
	10. **SHIFT SWAPPING** We hear **operators want to be able to swap shifts** with each other, allowing them greater flexibility to accommodate personal commitments.		▪ C2: Foster Collaborative Union Engagement ▪ T3: Promote Employee Autonomy
	11. **EASYING SHIFT SELECTION** We want to explore how **new technology** can allow operators **to select available shifts** based on their own availability and preferences.		▪ T4: Implement Electronic Picking ▪ C3: Offer Training Opportunities
	12. **STAGGERED START TIMES** We are thinking about staggering start times t**o reduce peak-hour congestion for operators** and better accommodate their individual needs.		▪ S3: Implement Integrated Scheduling for Runcutting ▪ P3: Optimize Service Frequency and Span
	13. **PREFERRED ROTATIONS** Our agency is looking into **creating rosters of shifts** that allow operators to choose preferred rotations or sequences of shifts that best suit their lifestyles to improve work-life balance and operator retention.		▪ S4: Move from Cafeteria-Style Bidding to Rostering

Shift Assignment

	1. UNDERSTAND YOUR SHIFT ASSIGNMENT ISSUES OR LIMITATIONS	2. UNDERSTAND AND TAKE NOTE OF YOUR PRACTICES	3. IF YOU'RE HAVING THIS ISSUE, SEE STRATEGIES LINKED BELOW
COMMON ISSUES	14. **SENIORITY** At our agency, we want to **rethink how we prioritize assignments** based on seniority to promote fairness for newer operators who are just starting out.	**Use this space to take note of your agency's practices, similar issues, or barriers within processes at your agency*	▪ S4: Move from Cafeteria-Style Bidding to Rostering ▪ C1: Engage with Staff at all Levels
	15. **BIDDING CHALLENGES** Lower seniority operators are finding it increasingly **difficult to bid on shifts that comply with legal requirements**, such as minimum rest time between shifts.		▪ S4: Move from Cafeteria-Style Bidding to Rostering ▪ T2: Ensure Compliance
	16. **UNDESIRABLE SHIFTS** We want to **mitigate the impact of undesirable shifts** to improve bus operator retention.		▪ C4: Invest in Incentive Programs ▪ C5: Improve Communication and Feedback Channels
	17. **EQUITABLE SHIFT DISTRIBUTION** We want to **ensure an equitable distribution of both desirable and less desirable shifts** with a mix of shift types, including day, evening, and night shifts, among all operators to promote fairness.		▪ C1: Engage with Staff at all Levels ▪ C2: Foster Collaborative Union Engagement ▪ S4: Move from Cafeteria-Style Bidding to Rostering

Communication with Workforce

	1. UNDERSTAND YOUR ISSUES ABOUT COMMUNICATION WITH WORKFORCE	2. UNDERSTAND AND TAKE NOTE OF YOUR PRACTICES	3. IF YOU'RE HAVING THIS ISSUE, SEE STRATEGIES LINKED BELOW
COMMON ISSUES	18. **WORK SCHEDULE COMMUNICATION** At our agency, **schedules are primarily posted in physical locations or sent via email**, but not all operators have easy access to these methods.	**Use this space to take note of your agency's practices, similar issues, or barriers within processes at your agency*	▪ C5: Improve Communication and Feedback Channels ▪ T4: Implement Electronic Picking
	19. **UPDATES** We provide updates about **work schedule changes**, but the timing is inconsistent, and not all operators receive the information in a timely manner.		▪ C5: Improve Communication and Feedback Channels ▪ T3: Promote Employee Autonomy ▪ T4: Implement Electronic Picking
	20. **FEEDBACK CHANNELS** Our **channels for feedback on scheduling are informal** and often don't lead to actionable changes.		▪ C5: Improve Communication and Feedback Channels
	21. **TRAINING** Although we occasionally **conduct sessions to explain scheduling processes**, they are infrequent and not well-attended.		▪ C3: Offer Training Opportunities

Strategies

Strategies are organized into four topic areas: scheduling techniques (S), agency culture and morale (C), planning (P), and technology solutions (T). Use the self-assessment to determine which strategies might be useful to your agency—or browse the strategies for ideas. Review the useful metrics suggested for each strategy—these indicators will help your agency understand how it is performing in the topic area.

SCHEDULING TECHNIQUES

S1: Understand Your Runtimes

Understanding runtimes is crucial in transit operations planning as it impacts service efficiency and operator satisfaction. Runtime analysis measures the time required to complete a one-way trip on a route, accounting for variations by time of day and day of the week using historical data from onboard systems.

Start by collecting and analyzing data to capture runtime variations. Using your agency's target on-time performance measure and target on-time performance window, identify discrete time periods that could actually achieve the desired on-time performance. For example, if your agency has an on-time performance target of 80 percent and a window of one minute early and five minutes late (an allowable span of six minutes), identify time periods during which 80 percent or more of your runtime observations fall within that specified time period. This may mean more discrete time periods throughout the day to find periods of the day during which enough trip observations have similar runtimes to meet the on-time performance target.

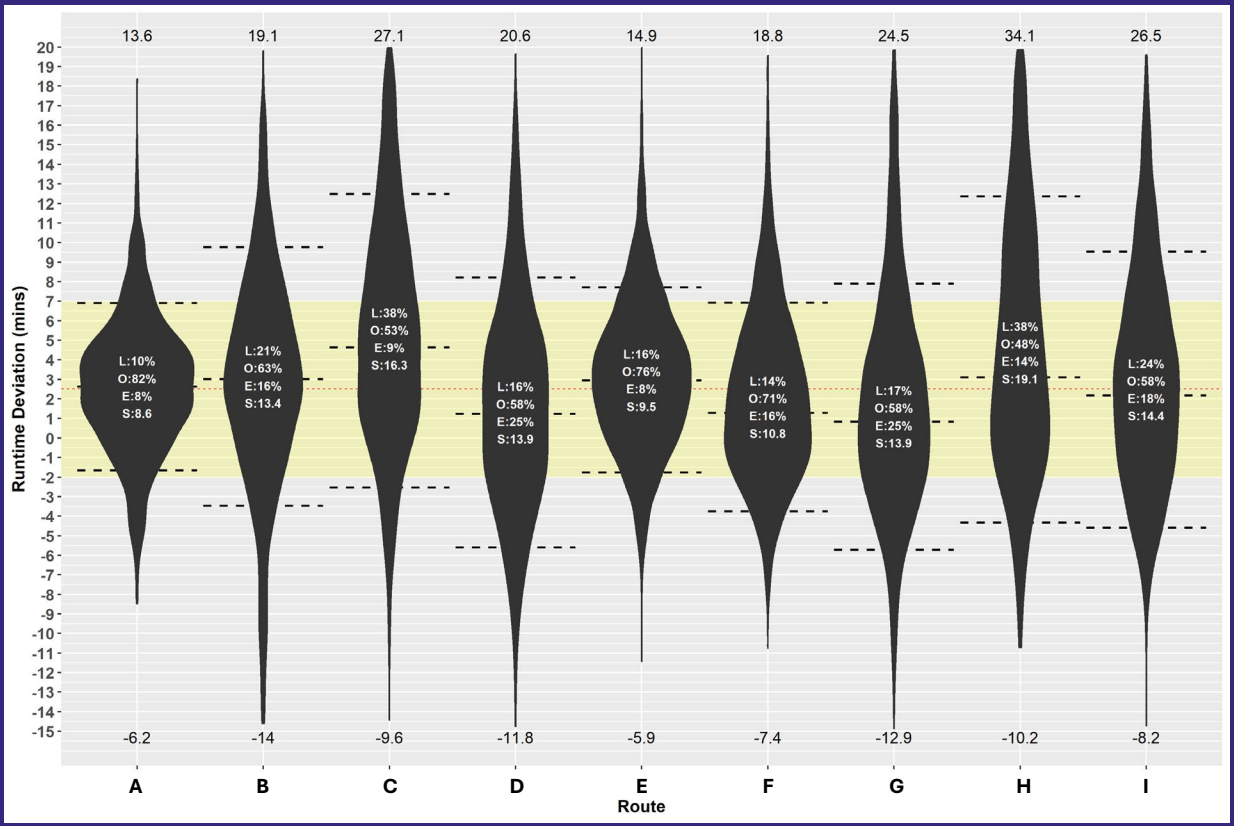
Agencies should constantly be monitoring runtimes and schedule adherence. Routes consistently exceeding planned runtime may require schedule adjustments or route modifications to enhance efficiency. Key performance indicators (KPIs) from runtime and cycle time analyses highlight inefficient routes or those lacking natural rest opportunities for operators. By continuously monitoring and adjusting routes based on this analysis, transit agencies can achieve a well-balanced, cost-effective, and driver-friendly operation.

Key Metrics to Collect

- **Runtime and Cycle Time Variability:** Captures variations in runtime and cycle times across different periods. Identifies operational challenges requiring schedule adjustments.
- **Schedule Adherence:** Monitors alignment of actual runtimes times with planned schedules. Evaluates scheduling accuracy and the need for adjustments.
- **Operator Rest Opportunities:** Tracks rest periods for operators on each route. Ensures compliance with labor regulations and enhances operator satisfaction.

Is “On-Time” Achievable?

The first question agencies should ask about their runtimes is if being on time is actually achievable. The graph below displays runtime observations for a series of routes in one time period. The target on-time performance for this agency is 80 percent, and the window of on-time is two minutes early and seven minutes late—the nine-minute window is shaded in light yellow across the graph. The dotted lines represent the smallest window of variation in runtimes to capture 80 percent of the observations. As you can see, only route A had 80 percent of its observed runtimes within a nine-minute window. The runtimes for the remaining routes varied so much that an 80 percent on-time performance is not possible, no matter what runtime is selected.



In this scenario, the transit agency must look for either more discrete time periods where 80 percent of runtime observations can be found within the allowable nine-minute window, or they must look for other interventions such as bus priority infrastructure or route and pattern simplification (see P3: Improve On-Time Performance and P5: Streamline Bus Routing).

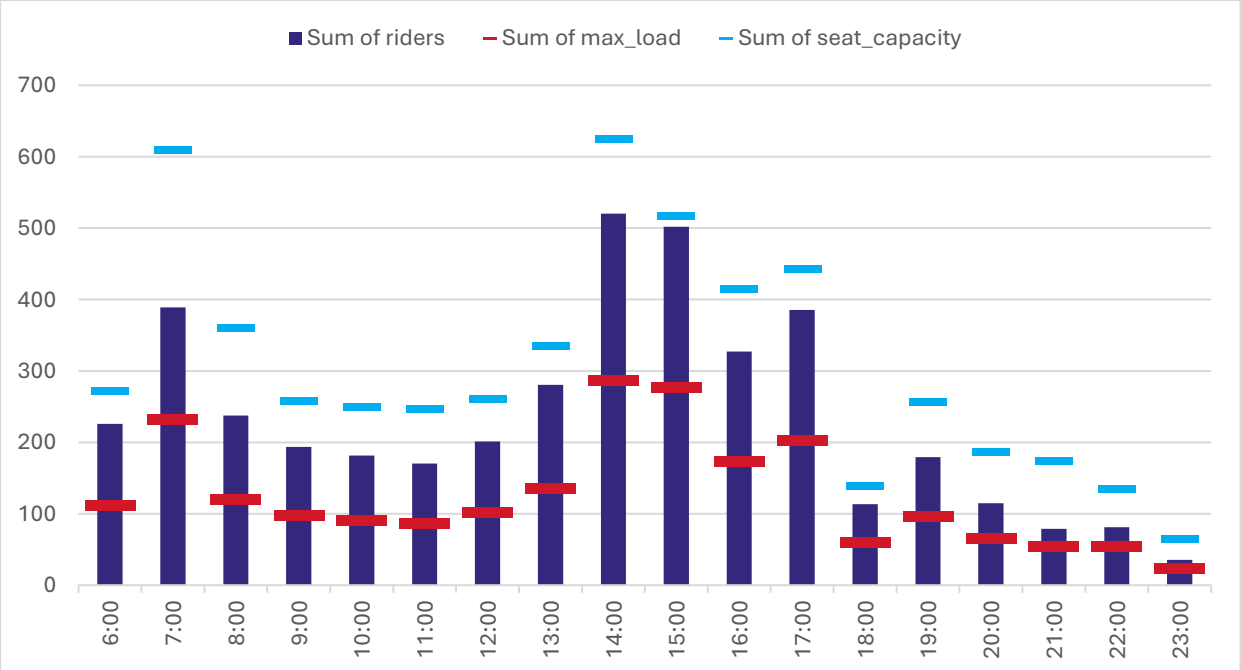
S2: Understand Your Service Demand

Service demand analysis helps agencies understand the transit level of service needs across the day for efficient resource allocation. By examining demand patterns throughout the day and different days of the week, service demand analysis can help schedulers and planners identify periods of highest and lowest demand, which is essential for determining the number of shifts required later in the rostering process. Overcrowded vehicles can be a stressor for operators and can cause on-time performance issues when not addressed since overcrowded buses tend to experience longer dwell times at stops as passengers take longer to board and alight.

Do My Service Levels Match Demand?

One of the simplest ways to understand if service levels match ridership demand is to examine route ridership and available capacity. The graph below shows the ridership, load, and available seated capacity for one route, in one direction from 6:00 a.m. to 11:00 p.m. The light blue bars represent the total number of available seats within a given hour of the day, the dark blue bars represent the total ridership on that route in the given hours, and the red bars present the sum of the max loads across all trips in the hour. Where the light blue and red bars begin to converge, such as in the 6:00 p.m. or 11:00 p.m. hours, the sum of max loads across all trips (red bars) is approaching the available capacity on the route (light blue bars). This may be a difficult period for operators. However, most of the day, particularly in the 7:00 a.m. and 2:00 p.m. hours, the light blue and red bars appear far apart, indicating there may be excess capacity (and excess trips) in the schedule. This is an opportunity to reallocate staff and vehicle resources elsewhere in the system.

Note that routes with directional demand may have excess capacity in one-direction during opposite times of the day. Service levels and ridership demand should be examined by each direction.



Integrating service demand analysis into the scheduling process ensures that scheduled services align with actual demand. This balanced approach enhances overall system effectiveness and reliability, preventing inefficiencies and reducing operator stress.

Key Metrics to Collect

- **Peak vs. Off-Peak Ridership:** Comparison of passenger volumes during peak hours versus off-peak times to understand demand fluctuations.
- **Daily/Weekly/Monthly Ridership Trends:** Tracking ridership over different periods to identify patterns, seasonal variations, or growth/decline trends.
- **Vehicle Load**: The ratio of passengers on board to the seating (and standing) capacity of the vehicle, indicating how full the buses are during different times of the day.
- **Overcrowding Incidents**: Frequency and location of overcrowded vehicles, where demand exceeds capacity.

S3: Implement Integrated Scheduling for Runcutting

Integrated scheduling aims to create a balanced schedule that optimizes both vehicle utilization (blocking) and operator efficiency (runcutting) by considering them simultaneously. This approach avoids the pitfalls of optimizing one at the expense of the other and ensures a more efficient and harmonious schedule.

Traditionally, vehicle blocking and runcutting are treated as separate processes. First, schedulers create blocks of trips that maximize vehicle efficiency—minimizing deadhead time, ensuring optimal bus utilization, etc. After blocking is complete, the runcutting process takes these blocks and tries to fit them into shifts for operators. This can lead to suboptimal outcomes, where highly efficient vehicle schedules may result in complex, fragmented, or less desirable work shifts for operators.

Integrated scheduling concurrently reblocks while runcutting, ensuring balanced optimization. Instead of finalizing the blocks first and then moving to runcutting, the scheduler continuously adjusts blocks while considering the impact on operator shifts. This means that small adjustments in vehicle blocks might be made to significantly improve operator schedules, achieving a balance between the two.

In an integrated scheduling approach, a scheduler might start with a preliminary vehicle block that minimizes deadhead time but results in a long mid-day gap for the operator. Instead of accepting this as is, the scheduler adjusts the block by reassigning some trips to different blocks, creating a more continuous workday for the operator with minimal idle time. For example, instead of a block that has a long break between morning and evening trips, the scheduler shifts trips around to ensure the operator works a consistent shift from 6:00 a.m. to 1:30 p.m. with a short break, balancing vehicle efficiency with operator satisfaction. This iterative process allows for trade-offs, where a slight compromise in vehicle efficiency can result in significantly better operator schedules, leading to an overall more efficient and effective transit service.

Key Metrics to Collect

- **Operator Unproductive Time:** Tracks time operators spend not engaged in productive work. Minimizes idle time and improves operator schedules.
- **Shift Fragmentation:** Assesses split shifts and helps create more cohesive and desirable shifts.
- **Spread Time:** Measures the total time from the start to the end of an operator's workday. Ensures compliance with regulations and improves work-life balance.
- **Percentage of Paid Guarantee Hours:** Measures the proportion of total paid hours that are attributed to paid guarantee (make-up time) compared to the total scheduled hours.

S4: Move from Cafeteria-Style Bidding to Rostering

Rostering is a strategic approach in transit scheduling that creates weekly work packages for drivers to bid on, as opposed to cafeteria-style bidding where drivers choose their own workdays and days off. This method organizes trips into cohesive weekly packages, allowing transit agencies to maintain better control and oversight, ensuring balanced work distribution.

Rostering provides enhanced control by aligning schedules with operational needs, preventing inefficiencies, and supporting a consistent and reliable work environment. It addresses equity by offering fair opportunities to all drivers, reducing the disparities seen in cafeteria-style bidding where senior drivers often get the best shifts.

Rostering improves operational efficiency by maximizing resource utilization and ensuring all shifts are covered. The predictability of rostering increases driver satisfaction by allowing advance planning, leading to higher job satisfaction and potentially lower turnover rates. It also allows flexibility within a structured framework, accommodating individual preferences while maintaining overall fairness.

In summary, rostering offers a structured, balanced approach to scheduling that enhances control, fairness, efficiency, and driver satisfaction, leading to a more effective and equitable work environment.

Key Metrics to Collect

- **Operator Satisfaction:** Surveys operators regarding their schedules to gauge the effectiveness of rostering and identifies areas for improvement.
- **Shift Equity Analysis:** Assesses fairness in shift distribution among operators. Ensures equitable scheduling practices.

AGENCY CULTURE AND MORALE STRATEGIES

C1: Engage with Staff at All Levels

Engaging with staff at all levels of the organization is crucial for fostering a positive work environment and enhancing overall morale. Involving various departments such as planning, scheduling, front-line staff, and operations ensures a comprehensive understanding of the challenges and opportunities related to scheduling practices within the agency. Engaging with staff at all levels when solving operator scheduling issues ensures that diverse perspectives are considered, leading to more effective and practical solutions. This approach fosters greater buy-in, improves communication, and builds trust, ultimately enhancing employee satisfaction and retention.

Effective engagement can be achieved through multiple formats:

- **Regular In-Person Meetings and Workshops**: Facilitating face-to-face interactions fosters open communication and strengthens relationships among team members. Workshops can be used for brainstorming sessions, problem-solving, and sharing best practices.
- **Focus Groups**: Small, targeted discussions allow for in-depth exploration of specific issues and provide a platform for staff to voice their opinions and ideas.
- **Surveys**: Collecting feedback through surveys encourages honesty and helps identify areas of concern without fear of retribution.
- **Digital Engagement**: Utilizing social media, website updates, and other digital platforms ensures continuous communication and keeps staff informed about organizational developments.

- **Incentive Programs**: Recognizing and rewarding staff for their contributions can boost morale and motivation. Incentives can range from monetary rewards to public recognition and career advancement opportunities.

Key Metrics to Collect

- **Employee Satisfaction Scores**: Collected through regular surveys to gauge overall job satisfaction and identify areas needing improvement.
- **Participation Rates**: Tracking attendance and involvement in meetings, workshops, and focus groups to measure engagement levels.
- **Turnover Rates**: Monitoring changes in staff turnover to determine the impact of engagement initiatives on employee retention.

C2: Foster Collaborative Union Engagement

Fostering collaborative engagement with the union is crucial for understanding scheduling concerns and the successful implementation of any changes in work schedule policies and procedures. By continuously engaging with the union and involving union representatives early in the process of planning and implementing work scheduling changes, agencies can build a strong partnership based on trust and mutual understanding. This approach ensures that the needs and concerns of union members are considered, leading to more productive discussions and smoother implementation of new policies or changes. When both the agency and the union work together, it helps protect employees' rights while achieving shared goals.

Key Metrics to Collect

- **Union Feedback**: Collect regular feedback from union representatives to monitor ongoing concerns and satisfaction with the collaboration process.
- **Implementation Success Rates**: Assess the success of implemented changes that involved union negotiation and collaborative engagement.

C3: Offer Training Opportunities

Offering training opportunities equips operators and scheduling staff with a deeper understanding of the scheduling process, reducing errors, and empowering them to manage schedules more effectively. This fosters more efficient, operator-friendly scheduling practices, improving job satisfaction and fewer conflicts. Additionally, training programs keep employees current with industry best practices, technologies, and regulations, demonstrating the agency’s commitment to staff development and enhancing overall job performance and satisfaction.

Key Metrics to Collect

- **Training Participation Rates**: Monitoring the number of employees participating in training programs to ensure widespread access and engagement.
- **Employee Feedback**: Gathering feedback on training content and delivery to continuously improve the training offerings.

C4: Invest in Incentive Programs

Incentive programs, such as shift differentials and financial bonuses, play a crucial role in addressing scheduling issues by making undesirable shifts more attractive and encouraging flexibility among operators. By offering higher pay for night or weekend shifts, for example, agencies can ensure better coverage and reduce the reliance on overtime or the extraboard. These incentives can enhance job

satisfaction and retention by recognizing operators' efforts while helping to balance workloads and improve overall performance.

Key Metrics to Collect

- **Shift Fill Rates:** Measure the percentage of shifts filled by scheduled operators versus those needing coverage from the extraboard or through overtime. Low fill rates for less desirable shifts may indicate a need for incentives.
- **Overtime Hours:** Monitor the amount of overtime worked. High levels of overtime can indicate a lack of coverage and may suggest that incentives are needed to attract operators to less popular shifts.
- **Shift Preferences:** Analyze patterns in shift preferences and coverage requests. If operators consistently avoid specific shifts, it may be an indicator that incentives are needed to balance the schedule.
- **Shift Coverage Rates:** Measure the percentage of shifts covered without needing overtime or additional extraboard staffing.
- **Cost of Incentives vs. Savings:** Compare the costs of implementing incentive programs with the savings achieved through reduced turnover and improved scheduling efficiency.

C5: Improve Communication and Feedback Channels

Improved communication and feedback channels can significantly address operator scheduling and retention issues by fostering a more inclusive and responsive work environment. Enhanced communication facilitates a two-way dialogue between operators and schedulers, allowing operators to express their concerns and preferences, which can lead to more tailored and effective scheduling solutions. When operators feel their input is valued and acted upon, it increases their satisfaction and trust in the scheduling process.

A structured feedback system means that concerns are systematically collected, acknowledged, and addressed (when possible), leading to changes that can improve scheduling practices and operators' satisfaction. This responsiveness boosts operator morale and retention by demonstrating that their feedback is heard.

Key Metrics to Collect

- **Feedback Response Rates:** Measure the percentage of feedback submissions that receive a timely and actionable response.
- **Employee Retention and Satisfaction Rates:** Evaluating the correlation between new benefits and improvements in retention and overall job satisfaction.

PLANNING STRATEGIES

P1: Ensure Adequate Layover Times

Ensuring adequate layover times is crucial for maintaining a reliable and efficient transit service while prioritizing operator well-being. Layover times allow operators to rest, recover, and prepare for the next trip, which helps reduce fatigue and enhance service reliability. To ensure adequate layover times, agencies should collect data on current layover durations and gather feedback from operators regarding the sufficiency of these breaks.

Adequate layover times can be determined by analyzing data from Automatic Vehicle Location (AVL) systems and reviewing operator feedback to identify any discrepancies or areas of concern. This process

ensures that layover times are aligned with operational needs and operator requirements, ultimately contributing to improved on-time performance and operator satisfaction.

Key Metrics to Collect

- **Average Layover Duration**: Measure the average time allocated for layovers to ensure it meets recommended standards.
- **Operator Feedback**: Regularly survey operators to assess their satisfaction with layover durations and identify areas for improvement.
- **On-Time Performance**: Track the impact of layover times on overall service punctuality.

Are Layover Locations Adequate?

Providing adequate layover locations is essential for ensuring the safety, comfort, and well-being of transit operators. Layover locations should be strategically placed, ensuring they are safe, well-lit, accessible, and equipped with essential facilities such as restrooms and break areas. Safety and accessibility can be assessed by conducting regular site evaluations and gathering operator feedback. Ensuring that layover locations meet these criteria helps enhance operator satisfaction and reduces stress, ultimately contributing to a more reliable and efficient transit service.

P2: Improve On-Time Performance

When on-time performance is enhanced, operators face fewer instances of reduced layover time, extended hours, or unexpected delays, leading to increased job satisfaction and reduced stress. Better on-time performance boosts operational efficiency by allowing for more accurate scheduling and resource allocation, which minimizes the need for constant adjustments and helps in maintaining compliance with service agreements and regulatory requirements.

Agencies can identify areas where performance can be improved using systems to monitor adherence to schedules. Adjusting schedules based on real-time data or building additional recovery time into schedules for more unreliable routes helps mitigate delays and ensure that buses can adhere to their schedules even in high-traffic conditions. However, bus-priority infrastructure, such as transit signal priority (TSP), dedicated bus lanes, and queue jumps, is essential for improving on-time performance by reducing delays caused by traffic congestion and signal waits. These measures allow buses to maintain consistent travel times, leading to more reliable and predictable schedules. As a result, operators experience less stress from schedule variability, leading to higher job satisfaction and reduced fatigue.

Key Metrics to Collect

- **Schedule Adherence:** Monitors alignment of actual cycle times with planned schedules. Evaluates scheduling accuracy and the need for adjustments.
- **Delay Reports**: Track incidents of major delays and their causes.

P3: Optimize Service Frequency and Span

Optimizing service frequency and span involves adjusting the number of trips and the times services are available. By aligning service frequency with actual demand and adjusting the span of service to cover both peak and off-peak hours, agencies can create more balanced and manageable shifts. Also,

spreading out service across the day rather than concentrating it solely during peak hours can reduce the occurrence of split shifts. This approach minimizes downtime and creates more continuous, manageable shifts, leading to improved operator satisfaction and fewer scheduling disruptions. Lastly, well-optimized frequencies and spans reduce the need for last-minute adjustments or overtime, leading to more stable and predictable work hours for operators.

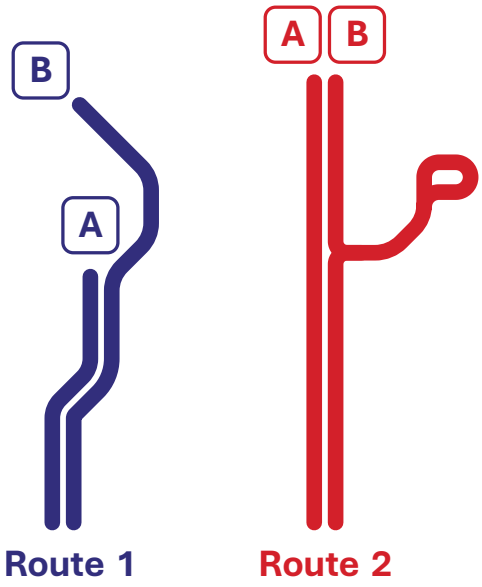
Using Automatic Passenger Counters (APCs), agencies can continuously monitor ridership patterns and adjust service levels accordingly. Key performance indicators (KPIs) should be developed to guide these adjustments, ensuring that services meet demand during peak and off-peak hours. Additionally, engaging with stakeholders, piloting new schedules, and exploring models like microtransit can further enhance service optimization.

Key Metrics to Collect

- **Service Frequency and Span KPIs**: Develop and monitor KPIs to ensure service levels match ridership demand.
- **Stakeholder Feedback**: Engage with stakeholders to gather input on service frequency and span needs.

P4: Streamline Bus Routing

Streamlining bus routes involves simplifying them to reduce detours, which enhances overall service efficiency and reliability. When routes include variations, such as short and long patterns (Route 1) or deviations from the main service area (Route 2), it results in different runtimes. These variations often require adjustments to layover times to maintain a consistent cycle time. For example, a route with trips that have 10-minute and 15-minute layovers can create schedule irregularities, causing operators to rush or wait, which disrupts service flow. This complexity complicates scheduling and makes it harder to ensure reliable service. By minimizing deviations and unnecessary patterns, transit agencies can better utilize resources, improve operational efficiency, and create more predictable schedules for operators. This approach not only simplifies operations but also enhances service consistency and reliability, benefiting both operators and passengers.



Key Metrics to Collect

- **On-Time Performance**: Percentage of buses arriving at their stops on time.
- **Layover Time Variability:** Differences in layover times between different trips.

TECHNOLOGY SOLUTIONS

T1: Develop Scenarios

Scenario development involves using advanced planning and scheduling tools to create, compare, and validate timetabling, blocking, and crewing scenarios subject to different conditions. Optimization algorithms and artificial intelligence can be leveraged during scenario development by automating the scenario creation process while producing resource-efficient and robust scenarios and allowing for data-

driven decision-making. The approval process of newly developed scenarios can be supported via web sharing to gather precious feedback from critical stakeholders before implementation.

Key Metrics to Collect

- **Scenario Success Rates**: Measure the effectiveness of different scenarios in achieving desired outcomes, for example, by measuring the reliability of a new timetable scenario supported by CAD/AVL runtime measurements.
- **Cost-Benefit Analysis**: Evaluate the financial implications of each scenario.
- **Impact on Resources**: Assess the impact on the current fleet and workforce.
- **Comparison Report**: Compare the scenario with a historical reference scenario from the same calendar period.

T2: Ensure Compliance

Leveraging technology to ensure compliance with regulatory requirements and labor agreements is essential. Scheduling and dispatching systems can incorporate all mandatory constraints and regulations to automatically monitor adherence to rules and provide alerts for potential violations, helping agencies maintain compliance and avoid penalties. Such systems can often keep records of decisions leading to a voluntary compliance breach, for example, if done by mutual agreement with the union representative.

System validations can also be leveraged to block user actions that would introduce a compliance issue, such as respecting the minimum rest duration for an operator when assigning shifts or respecting operator qualifications.

Key Metrics to Collect

- **Compliance Violation Reports**: Track instances of non-compliance and their causes.
- **Automated Alerts**: Monitor the effectiveness of automated compliance alerts in preventing violations.
- **Regulatory Audit Results**: Evaluate the outcomes of regulatory audits to ensure ongoing compliance.

T3: Promote Employee Autonomy

Providing employees with autonomy through technology, such as self-service scheduling tools, empowers them to have greater control over their work schedules. Self-service tools can also save much time for the agency's dispatchers and administrative clerks by reducing the volume of phone calls and in-person meetings and removing the need for manual data entry for processes like vacation requests or work exchange requests. They also provide an efficient way for employees to indicate if they are available or not to perform overtime.

Self-service tools can also be used to communicate with employees through messages and ensure that employees are informed about changes to their schedules, disruptions, or other events as soon as they happen.

Key Metrics to Collect

- **Usage Rates of Self-Service Tools**: Monitor how frequently employees use self-service scheduling tools.
- **Increased Productivity**: Once employees adopt self-service tools, the agency can expect more automation and a reduction of the time required to cover assignments or prepare the "board" for the next day.

T4: Implement Electronic Picking

Electronic picking systems for shift selection can streamline the scheduling process, reduce errors, and ensure fairness. These systems allow for transparent and efficient shift selection based on seniority and preferences while ensuring CBA or other working agreements are always enforced. Employees can search, filter, and visualize the details of the assignments.

When employees submit electronic choices, agencies don't have to relieve employees, which can greatly reduce the cost of their picks. Remote picks allow employees to submit their choices without going to the division on their vacations or days off.

Without being physically at the division, electronic picking systems allow employees to monitor picks' progression and remaining choices in real-time. Typically, employees can start building their list of choices when the work is posted. As the picks progress, employees can revisit their choices to ensure they submit choices that are still available. Validations are also present to guide the employees so their choices respect their qualifications, accruals, regulations, and collective bargaining agreements.

Key Metrics to Collect

- **Shift Selection Efficiency:** Measure the time to complete shift selection processes.
- **Error Rates:** Track the frequency of errors in shift assignments. When all choices are entered electronically, the number of errors should be almost inexistent.
- **Adoption Rate:** A smooth onboarding of the employees is critical for the success of these systems. The benefits of these systems are proportional to the adoption rate.
- **Satisfaction Rate:** Survey your employees to know their satisfaction with the electronic systems. If employee satisfaction is below expectation, training, promotion, or even modifications to the system might be required.

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