



# Turning Data into Actionable Insights

How to Drive Change Through Passenger Movement Analysis

# INTRODUCTION

Consider a typical commute in a large city. It's Friday night and you leave work. You may head for the subway: tap your travel card on the gate to enter the station, then catch a train home; switch lines once or twice and exit the station at your destination without necessarily tapping out. Or you might simply catch a bus and use your contactless card to pay for the fare. Or—drive home on a toll road. No matter what your commute looks like, it generates vast amounts of data.



**LIMITED ANALYTICS TOOLS, INCOMPLETE DATA SETS, AND A LACK OF INTEGRATION BETWEEN DATA MANAGEMENT SYSTEMS PREVENT MOST CITIES AND MOST TRANSIT AGENCIES FROM UNDERSTANDING THE FULL-PICTURE OF DAY-TO-DAY OPERATIONS TO MAKE EFFICIENCIES AND TURN UNSTRUCTURED DATA INTO ACTIONABLE INSIGHTS.**

The transit industry is well equipped to capture this data through automatic fare collection systems, passenger counters, toll tag scanners, traffic light sensors, transaction histories, Automatic Vehicle Location (AVL) systems, Internet-of-Things (IoT) endpoints, social media feeds and more. Yet, while the number of data endpoints continues to grow, making sense of this information is more challenging than ever. Limited analytic tools, incomplete data sets, and a lack of integration between data management systems prevent most cities and most transit agencies from understanding the full-picture of day-to-day operations to make efficiencies and turn unstructured data into actionable insights.

The value of those insights is clear. From helping city managers analyze why traffic forms at unexpected times, to identifying transportation dead zones or optimizing fleet schedules, the opportunities to apply data insights are vast. As cities and transit agencies mature in their data journey, they are increasingly looking to data to understand passenger travel habits: how, when, and where people are moving around, as well as why, and apply this knowledge to manage ridership, optimize transit networks and improve service performance.

To take advantage of data insights, transit agencies need to adapt their data analytics approach. It starts with a focused effort to consolidate the right data for monitoring current (and historic) state of the transit network, followed by an iterative application of advanced analytics tools to form a complete picture of passenger movements. Passenger movement analysis covers a wide variety of information, including trip segments that extend beyond the transit shelter or platform. This level of analysis leverages multiple agency data sources from across a multitude of transit modes, fare

collection, passenger count, vehicle location and behavior trends to better identify anomalies, improvements, and opportunities to influence change.

In this white paper, Cubic Transportation Systems will look at how advanced analytics tools, such as Passenger Movement Analytics (PMA), can help agencies build a full picture of passenger mobility and become an ally in addressing transit challenges on three critical levels: providing seamless traveler experience, better tailoring service to demand and informing meaningful transportation policy that will make transit more equitable and sustainable for all.

## 1. PROVIDING SEAMLESS TRAVELER EXPERIENCE.

Transit agencies with access to passenger movement analytics can vastly improve the traveler experience on the transit network. The key lies in understanding traveler behavior. Knowing the temporal, geographic and mode preference is a fundamental step in helping agencies better cater to passenger demands and manage capacity more effectively.

Unfortunately, understanding passenger behavior is a challenging task. Looking at schedules alone, it can be hard for an agency to estimate how many passengers will choose to travel by one particular mode on a given day or gauge the quality of service on a given line. A fragmented view of passenger journeys on one particular mode or even across a transit network is also not enough to form a picture of something as complicated as people's travel choices. True understanding of passenger behavior requires insight into end-to-end journeys – from first to last mile. That understanding comes with advanced analytics tools, such as the Passenger Movement Analytics. The PMA supports a variety of analysis, for example, average passenger volume across different days, times, and peak/off-peak periods, inferences for destination and linked segments in a journey, demand estimation and planning, and more, to help agencies build a full picture of traveler mobility.

Establishing a good understanding of end-to-end journeys allows agencies to benchmark travel behaviors and use that information to make strategic and operational decisions. For example, if a traveler's primary mode choice is disrupted, an agency can propose a comparable mode change; knowing that the likelihood of the traveler accepting the proposal is high. It also means an agency can better mitigate the effect of a service

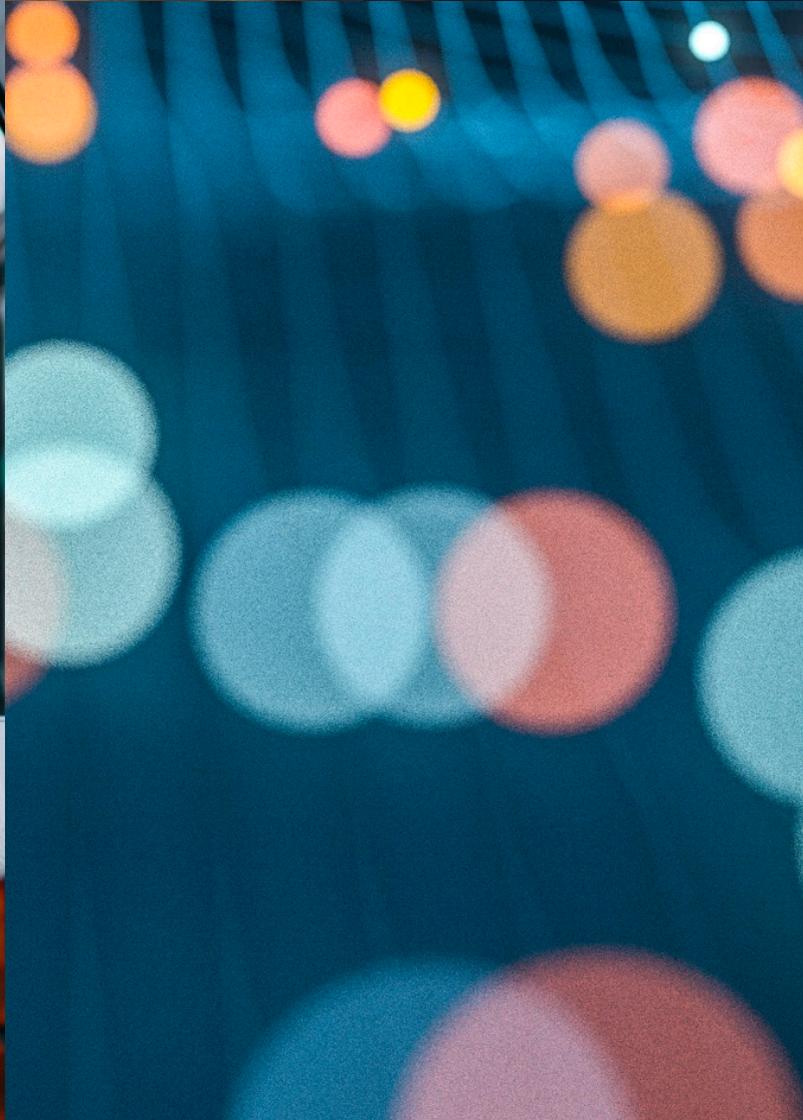
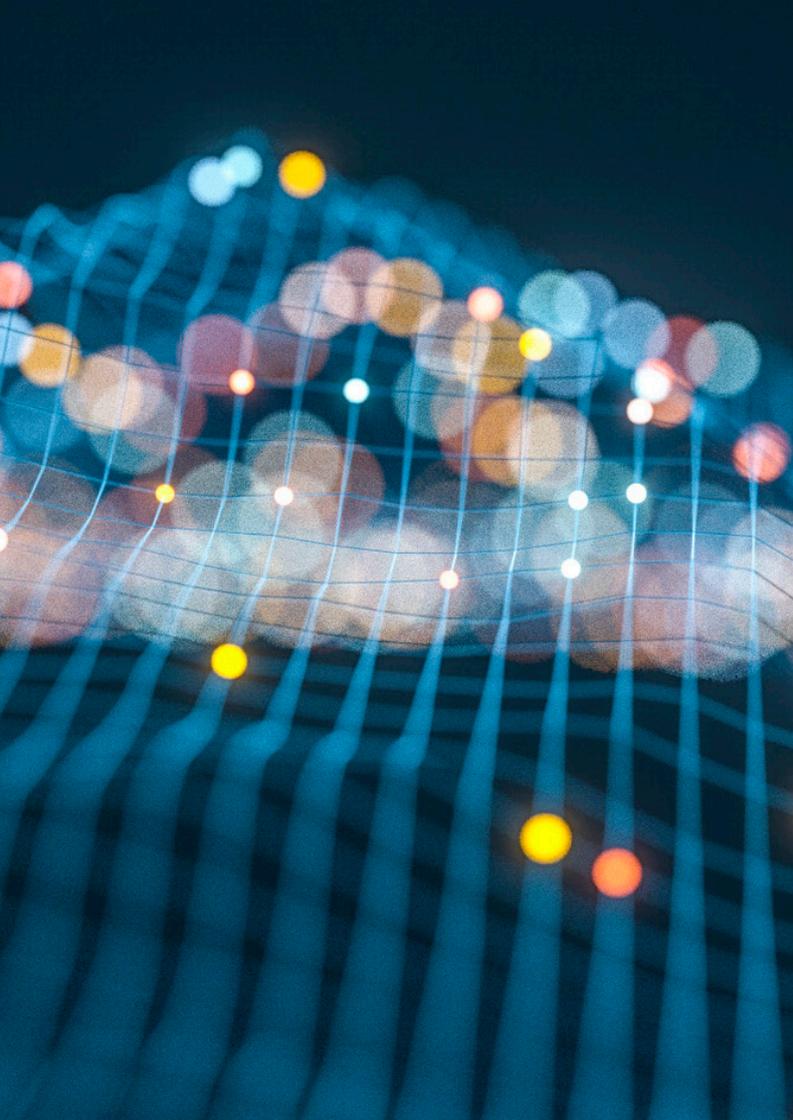
disruptions on the broader network, for example, by encouraging micro mobility or active modes of travel over a bus route with the same destination that's currently running at capacity. After a deep dive into passenger movement data, The San Diego Metropolitan Transit System improved traveler experience with more on-time services, as a result increasing ridership on bus and trolley lines.<sup>1</sup>

Agencies can also use passenger analytics data to provide travelers with personalized, timely and relevant digital prompts. Such prompts don't require a financial value to incentivize a traveler to take a preferred action, relying instead on behavioral mechanisms to influence change.<sup>2</sup> They serve a dual purpose: give travelers the right information to make choices that improve their experience and keep the network moving. Tools such as the PMA can help agencies form a picture of passengers' travel behavior and use the historical insight into behavior patterns and typical travel schedules to further optimize incentives or rewards to build more effective loyalty programs as long-term mechanisms for behavior change. Conversely, by connecting with advertisers, agencies can offer travelers who opt-in for the service even more personalized incentives. For example, by rewarding a passenger's decision to delay their travel time until a disruption on their daily route clears with a coupon or a discount to a nearby retailer or a coffee shop, agencies can further build loyalty by solidifying reliability in getting passengers where they are going, no matter what.

TO TAKE ADVANTAGE OF DATA INSIGHTS TRANSIT AGENCIES NEED TO ADAPT THEIR DATA ANALYTICS APPROACH. IT STARTS WITH A FOCUSED EFFORT TO CONSOLIDATE THE RIGHT DATA FOR MONITORING CURRENT (AND HISTORIC) STATE OF THE TRANSIT NETWORK, FOLLOWED BY AN ITERATIVE APPLICATION OF ADVANCED ANALYTICS TOOLS TO FORM A COMPLETE PICTURE OF PASSENGER MOVEMENTS.

<sup>1</sup> <https://www.govtech.com/dc/articles/Intelligent-Transit-Data-Improves-Transit-Efficiency.html>

<sup>2</sup> [https://altaplanning.com/wp-content/uploads/Behavioural-Insights-to-Transportation-Demand-Management\\_FINAL.pdf](https://altaplanning.com/wp-content/uploads/Behavioural-Insights-to-Transportation-Demand-Management_FINAL.pdf)



## 2. TAILORING SERVICE TO DEMAND

Every single day, agencies make decisions that are traveler-oriented. Without detailed insight into traveler behaviors, agencies have traditionally relied on “gut feel” decision-making, often looking to incomplete, aggregated or limited, “one-off” data sets, sometimes collected through labour-intensive, manual means, to inform their choices. This no longer needs to be the case. By allowing agencies to consolidate, integrate, standardize and develop commonalities between various disparate data sets and put them together into a unified picture, modern data analytic tools such as the PMA take data analysis a step further—from line-based performance evaluation to network-level, multimodal

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analysis. Since information on passenger movements impacts almost every level of an agency’s operation, understanding how travelers use the system can help agencies better tailor service to demand.

Cities and agencies that understand travel patterns can address issues of routine congestion, optimize schedules, and streamline services. With tools such as the PMA, an agency has the insight into service performance (like adherence or bunching and gapping) as well as number of passenger impacted empowering data-informed decisions and monitor the impact. Similarly, an agency can optimize bus routes and minimize any overlap in a bid to increase ridership and service efficiency. Boston’s MBTA already uses origin and destination data to inform planning decisions,<sup>3</sup> while in Houston, United States, data insights played part in the city’s decision-making process to update bus schedules to reduce service overlap and deploy new services in under-served areas, resulting in a 7% increase in bus ridership.<sup>4</sup> Arming agencies with data-driven decision-making offers measurable results: better understanding of traveler impact of service disruptions, ridership fluctuations, transfer points, peak/off-peak demand route scheduling, service delivery, and even corridor planning.

PMA provides analytic engines for traveler insights, inferred destination, and linking trips across modes. But beyond PMA, in a bid to keep riders happy, transit agencies can also tap into advanced analytics to better understand travelers’ attitudes and proactively address an immediate or future need. By using data like social media, call logs or even notes from a field

technician, agencies can apply analytics to improve. For example, machine learning algorithm applied to publicly available social media feeds to process key themes and measure customer sentiment. Social media listening and sentiment analysis helps agencies identify and respond to developing disruptions and network anomalies quicker than traditional measures.

## 3. INFORMING TRANSPORTATION POLICY.

Apart from driving change at the passenger and agency level, passenger movement information can also play an important part in helping inform public policy at city, regional or even federal level. Cities can turn to data to achieve and refine strategic policy objectives with measured outcomes, such as addressing inequality, lowering carbon emissions, and connecting people to regional employment centers.

A solid understanding of the end-to-end journey helps cities in four major ways:

- it allows them to perform equity analysis to ensure transit-poor areas remain top of mind and inform investment into new transit services or expanding existing mobility programs;
- it helps estimate the impact of various investments, such as alternative modes like micromobility programs;
- it enables decision makers to identify and prioritize areas and routes in need of subsidization;
- it can inform policy for promoting regional mobility programs such as road user charging or Mobility as a Service (MaaS).

<sup>3</sup><https://www.mbtabackontrack.com/blog/43-odx-model>

<sup>4</sup><https://usa.streetsblog.org/2016/08/17/a-year-after-houstons-bus-network-redesign-ridership-is-up/>

**CHOOSING THE RIGHT ANALYTICS TOOLS, IN ADDITION TO AN INCREASED FOCUS ON ESTABLISHING OPEN DATA AND TRANSPORTATION STANDARDS WILL HELP AGENCIES AND CITIES MOVE THE NEEDLE IN TRANSPORT MANAGEMENT AND ENSURE THEY MAKE THE RIGHT DECISIONS TODAY TO IMPROVE THE TRAVELER EXPERIENCE, OPTIMIZE THE TRANSIT NETWORKS AND MAKE CITIES MORE SUSTAINABLE AND EQUITABLE FOR YEARS TO COME.**

In one example of how data analysis can drive tangible change on a city-level, Cubic analyzed city-wide usage of bike-sharing services in Barcelona, Spain, to see if the city was providing enough capacity to service demand at peak hours. Utilizing advanced data analytics tools, Cubic monitored bike-share usage across Barcelona, analyzing the flow of bikes into the city center during the morning rush hour and back out in the afternoon to help city

planners decide whether existing capacity was serving the city well and build a business case for extending bike services in certain hot spots.

In time, cities could feed this type of analysis into pricing recommendations (e.g. dynamic pricing between various transit modes), which would alter the economic equation for travelers between driving alone and making multi-modal trips including transit. Such pricing could also take into account health and wider social outcomes to encourage citizens to walk more and ensure that people in communities without readily available transit could be offered equitable transportation. Coupled with financial incentives, passenger movement information can empower cities to shift specific riders away from transportation modes that are undesirable from the point of view of a city, such as private cars, to multimodal travel that's more environmentally friendly, or to alter other transit behavior on account of policy (e.g. door-to-door reduced fare benefits, habit forming discounts, such as two weeks of discount bus travel, and more).

The potential of utilizing advanced data analytics to inform city planning is promising, yet the big question centers around data ownership, shareability and safety. To allow agencies to share data securely without risking privacy, Cubic has developed a "De-Identification engine", which involves cleansing data beyond traditional techniques such as hashing to protect personally identifiable information while still maintaining the underlying analytic value of the data. While this is a critical step to laying the foundations of data security, as agencies and cities continue to collaborate further, they need to put smart data

management and integration front of mind, promote a culture of secure data sharing and work together towards establishing transportation data standards on the federal level that build on the existing standards for scheduling or reporting on ridership. For example, in Los Angeles, permitted shared use mobility providers already provide a variety of real-time travel information to the city.<sup>5</sup> As data sharing continues to be a point of discussion, the transportation industry should lead the effort, while maintaining strict governance over transit data ownership.

### **CONCLUSIONS**

After years of investment into digitized transit services capable of capturing vast amounts of structured, unstructured and disparate information, transit agencies are ready to reap the benefits of data insights but struggle to turn them into smart outcomes. To do that, they need the right tools or risk making the wrong conclusions. The stakes are high—in the data economy, misinformation can do more harm than good. Tools such as the PMA offer actionable insights into full customer journeys to help agencies understand passenger movements, predict passenger travel choices, improve route and schedule alignment, optimize fare products, and reduce operating costs. Choosing the right analytic tools, in addition to an increased focus on establishing open data and transportation standards will help agencies and cities move the needle in transport management and ensure they make the right decisions today to improve the traveler experience, optimize the transit networks and make cities more sustainable and equitable for years to come.

<sup>5</sup><https://www.nytimes.com/2020/02/05/technology/data-micromobility-electric-scooters-mds.html>

**CUBIC – A LEADER IN INTELLIGENT TRAVEL SOLUTIONS**

At Cubic, we believe our identity is intrinsically linked with our customers, and the people our customers serve. How they get from one place to the next – how that impacts their lives, their fellow travelers and their cities – and how it feels along the way.

That's why we're passionate about developing transportation solutions that improve the way we move throughout cities. Innovation is in our culture, and our history speaks for itself. In our 45-year history, we've delivered public transport fare collection systems to over 450 operators, including 20 regional back office systems, and traffic and transportation management systems for major cities and regions on four continents.

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