The past, present and future of transportation analytics

How data insights have evolved, and why they've never been more essential for Departments of Transportation.

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Introduction

In the last 20 years, technology has transformed every area of our lives – and the way we analyze transportation infrastructure is no exception.

Departments of Transportation (DOTs) now have the volume of data and analytical capabilities to gain a greater understanding of what's happening on our roads. And this technology has arrived just in time.

Our cities and the regions that surround them are changing faster than ever – so a deeper, more contextualized picture of people and goods movement has become a vital tool for planners and strategists who need to check the pulse of and continuously monitor their city or state. But this isn't just a necessary reaction to changing conditions: it's an opportunity to create new mobility strategies that improve our quality of life.

Armed with highly efficient methods for gathering context-rich insights, DOTs can plan for the future, and proactively create more efficient, safer road infrastructure.

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But how did we get here? And are departments implementing the right technology to give itself the best chance of meeting its targets?

Read on to find out.

Past Present Future

Choosing between context and volume

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Mail-in surveys

For many years, DOTs relied on mail-in surveys to monitor driver behavior. Commercial and residential drivers were given surveys and asked to provide information on their trip purpose and destinations. From these, DOTs could infer the most-used routes within their regions.

While this didn't provide them with the whole picture, it gave them a good sense of where the primary journey origin and destination points were across the areas they were responsible for. However, response rates were low and often biased – meaning that the data gained wasn't necessarily representative of wider road use.

> ...response rates were low and often biased...

Even when combined with manual forms of data collection – that is, a department employee standing on the side of a road, measuring traffic using a radar gun – the low response rates meant that mail-in surveys offered an incomplete picture of traffic behavior. Naturally, the surveys also relied on human recollection and anecdotal bias, impacting their accuracy further.

The amount of time it took for drivers to respond to the requests for information was another factor to consider. By the time the surveys had been collated into data repositories for analysts to look into, it was weeks or months since the surveys were filled out and traffic behavior was likely to have already shifted. Further latency in data consolidation and analysis meant that results could be 12 months old by the time they were ready for public consumption.

Fortunately, there was a new option on the way...

Fixed sensors

On-road sensors solved mail-in surveys' biggest problems instantly. They delivered far more accurate numbers for DOTs to analyze – and they did it at a much greater speed too.

Planners could receive and use accurate data within a matter of days, rather than a matter of months. For example, a road sensor could be installed at the entry point of major ports – giving planners supremely accurate counts of the vehicles coming in and out on certain days and at certain times.

> ...planners were only able to address the symptoms... rather than the underlying problem...

However, sensors deprived analysts of the context provided by traditional data capturing tools like surveys. There was no way to capture where the traffic came from or whether it was moving goods or people.

Without knowing the purpose or origin of drivers' journeys, planners were only able to address the symptoms – e.g., slow traffic on that particular road – rather than the underlying problem – e.g., a lack of suitable routes for heavy-duty commercial traffic.

Sensors also failed to capture an accurate picture of average speeds. They could register and report the speed the vehicle was traveling at one precise moment, but because this figure wasn't necessarily indicative of the vehicle's overall average speed, DOTs couldn't use it to infer a deeper understanding of congestion.

What's more, sensors were costly, which limited planners' ability to deploy them widely throughout a particular jurisdiction. So DOTs needed a universal, scalable method of capturing traffic behavior.

Past Present Future

Context meets volume

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Mobile phone data

Enter mobile phone data. This technology offers near real-time, higher quality information – so DOTs can respond to changes happening on the roads quickly and appropriately.

For example, analysts can quickly uncover reasonably accurate average speeds on roads, and give planners the evidence they need to install traffic-calming interventions like speed bumps. This is important because it allows them to cross-check anecdotal evidence – often citizen complaints – against the true figures, and prioritize accordingly, potentially saving lives in the process.

However, mobile phone data also has its drawbacks. Large buildings, tunnels and bridges can all interfere with data collection. And while analysts can infer average speeds by registering the time it takes to travel through obscured areas, this undermines the accuracy of the data. What's more, the frequency and granularity of collection doesn't lend itself well to precise intersection and signal timing metrics.

Even more importantly, mobile phone data offers no way of identifying trip purpose or vehicle class, meaning that DOTs using this method may not gain all the information they need to understand traffic conditions.

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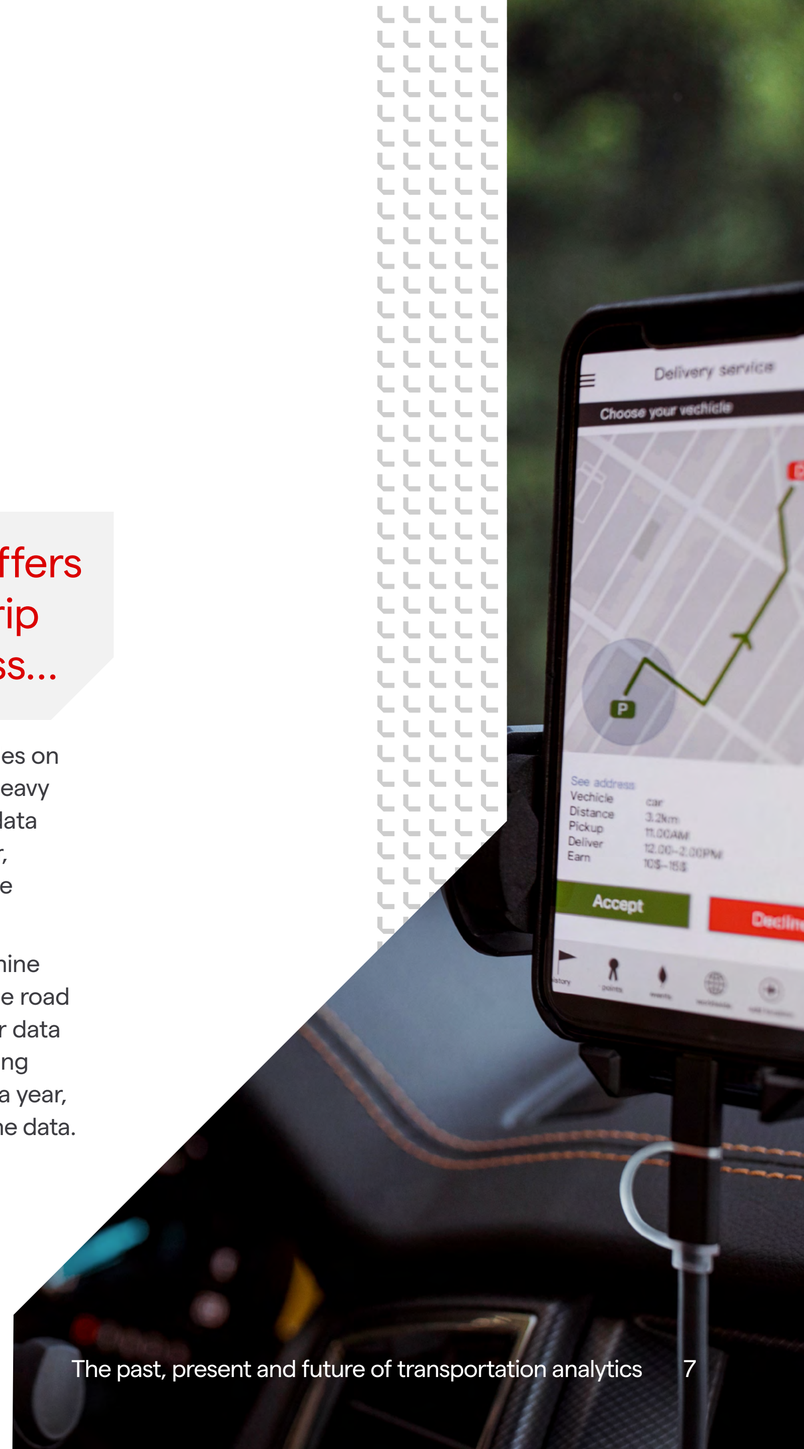
For example, heavy-duty commercial vehicles on their way to a warehouse may be causing heavy traffic in a certain area, but mobile phone data can't differentiate between this and smaller, last-mile delivery traffic – obscuring the true reasons for the congestion.

Mobile phone data also struggles to determine whether a car is traveling on one road or the road next to or underneath it – leading to further data quality issues. One instance of this happening wouldn't be too problematic. But over, say, a year, this can cause significant discrepancies in the data.



Connected vehicle data

Today, we have the technology necessary to process and aggregate massive volumes of traffic data. By accessing data from connected commercial and consumer vehicles, we can combine the positive elements of all other traffic data collection methods.

This technology offers the context of mail-in surveys alongside the volume of on-road sensors, and the near real-time nature of phone data. Connected vehicle data also works as well in built-up urban areas as it does in rural areas – giving departments the level of data reliability they need to justify spending, and ultimately ease congestion.

> ...create safer, more efficient, more cost-effective road infrastructure.

When combined with leading data science and AI practices, this data can be transformed into contextualized people and goods movement insights that help DOTs quickly identify and solve problems.

In turn, they can create safer, more efficient, more cost-effective road infrastructure.

Here are just a few examples:

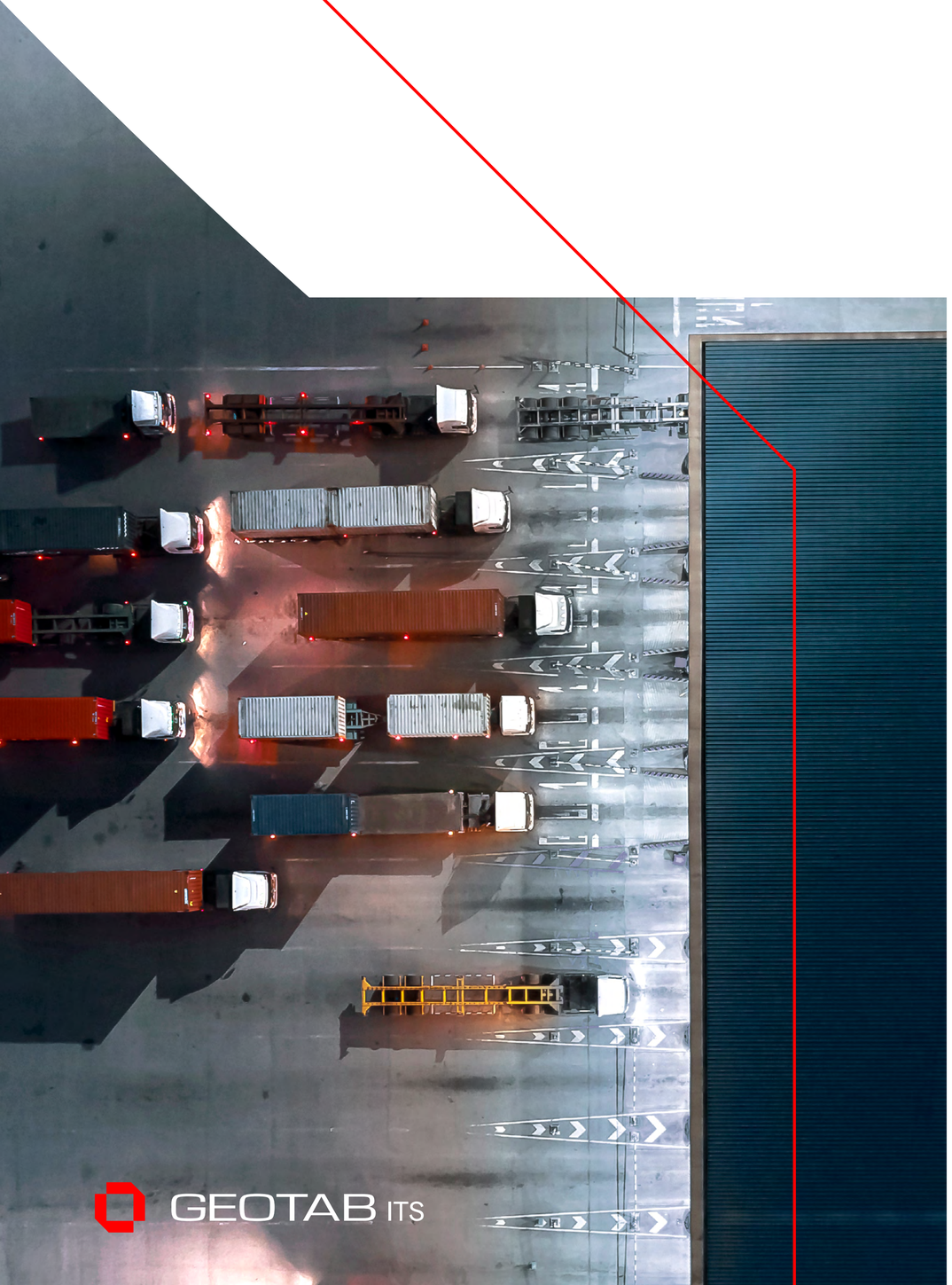
Port analysis

Analysts responsible for major ports can use high-volume, real-world data to infer the number of vehicles that visit the port, the average amount of time they're spending waiting in and around the port, and which routes they take to and from the port.

This provides them with a rock solid basis for suggesting upgrades to port infrastructure or the surrounding areas, and securing the grants needed to do so. Analysts can also work out how many drivers are using the best routes, and whether traffic signals need to be retimed to prioritize freight activity in the right places.

> Analysts responsible for major ports can use high-volume, real-world data...

Meanwhile, planners gain a sense of the key drivers behind overwhelming freight demand. They can drill into activity over time and figure out the key areas of congestion and inefficiency. And they can adjust infrastructure and policy to mitigate present and future obstacles.



Freight analysis

Similar logic can be employed for long-haul freight journeys. Once DOTs have identified bottlenecks that cause freight trucks to spend high amounts of time in traffic, they can more accurately estimate the cost of these delays and better justify funding.

For example, planners can examine popular routes to and from major distribution centers and explore the associated travel-time metrics and dwell times to help themselves understand potential freight bottlenecks.

> ...planners can examine popular routes to and from major distribution centers and explore the associated travel-time metrics...

They can also uncover how commercial vehicle journeys affect their region on a smaller scale. This includes analyzing services like last-mile delivery and curbside pickups and dropoffs to uncover hotspots, and discovering how commercial road usage impacts private citizen traffic.

Traffic calming

Just like mobile data, connected vehicle data can validate or contradict anecdotal evidence to help planners prioritize their traffic calming funding.

And connected vehicle data works as well in built-up urban areas as it does in rural areas – giving planning and engineering departments the level of data reliability they need to justify spending, and ultimately ease congestion.

The benefits also extend to traffic signaling. Users can understand how vehicle types and classes affect signal and corridor performance, and isolate the key contributors to congestion – whether it's longer queue lengths, slower starts and stops or split failures. DOTs can then use these insights to improve their traffic signal timing plans and level of service.

What's more, it's possible to characterize the expected impact of a traffic intervention before users have committed to it. And after the solution has been implemented, DOTs can also check their impact and ensure they haven't unintentionally created new congestion concerns elsewhere in the network.

For example, if they've changed the signal timing at a certain intersection, they can easily analyze traffic conditions before and after the change to measure the effectiveness of their solution. All this data also gives DOTs a much stronger basis for future action: they have all the evidence they need to gain funding and approval for their next intervention.

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Past Present Future

Unleashing intelligent data

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A hyper-connected network

Imagine a future where every vehicle and piece of infrastructure is connected. Where additional sensors track the movement of goods.

And where video footage backs up sensor data to guarantee 100% data accuracy. In this scenario, DOTs would gain a fully digital twin of the physical world that they can find problems and test solutions within – and AI would give them a helping hand with both of those tasks.

Advanced AI would help departments uncover inefficient movement of vehicles, and identify other problems like a lack of charging infrastructure. It would also automatically review recent solutions from similar cities and recommend them to DOTs – giving them complete visibility of the latest, most innovative methods.

DOTs will be able to foresee and mitigate against even the most complex problems facing their infrastructure.

Preparing for what's next

With full insight into the supply chain via connected vessels and goods, DOTs would be able to foresee and mitigate against even the most complex problems facing their infrastructure.

And they'd be able to achieve all this while retaining public confidence in their ability to protect personal data.

Here at Geotab ITS, we're helping DOTs embrace the future of transportation analysis. In fact, our Altitude platform is helping transform the way they diagnose problems and propose solutions.

You can find out more about Altitude here, or **get in touch today** to find out how we can address your specific needs.

Why Geotab ITS?

We uncover the insights you need to make smarter decisions about transportation in your region. With the help of our data science, AI, software engineering and user experience specialists, you gain a greater understanding of the context behind your traffic data. And in turn, you can create more sustainable, safer, and more efficient transportation systems.

Find out more at its.geotab.com

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