Use of data analytics in understanding transport

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The core of transport and logistics planning has not changed for the last 25 years.*

transport networks are modified or expanded based on complex interactions of politics, regional economics, policies and observed demand.

Transportation forecasting is key: estimating the number (and natures) of vehicles or people that will use a specific transportation facility in the future.

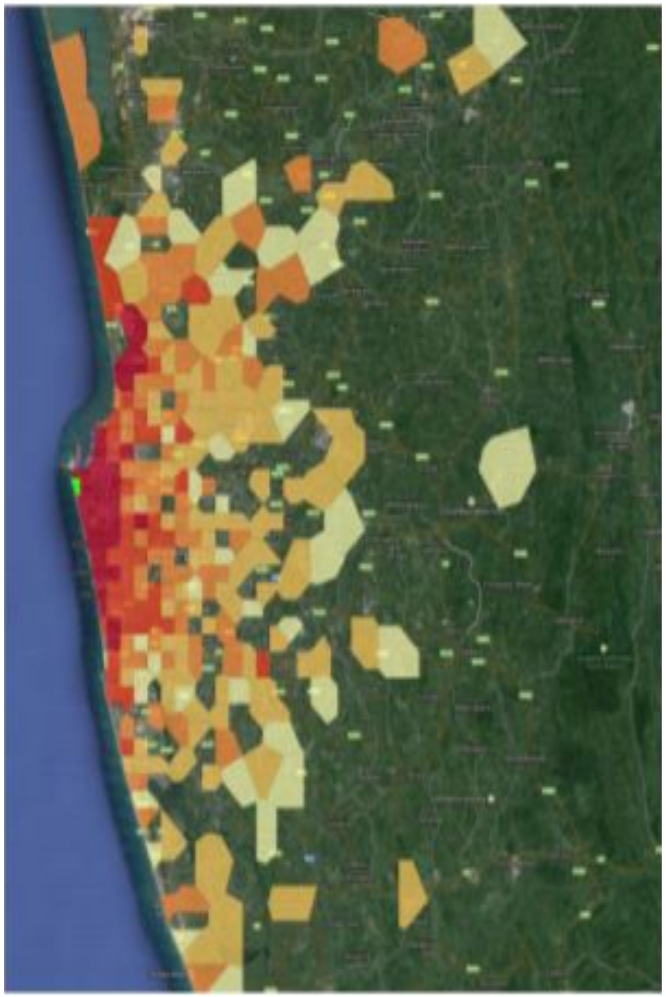
* Kirschbaum, https://www.door2door.io/

Typically, quantitative processes are used to assist decision-making

- **Trip generation**
  Determining the origins, destinations, number of trip made by people of a zone, and the purpose for which they travel.
- **Distribution analysis**
  Origins and destinations are then matched, often using a gravity model.
- **Mode choice analysis**
  Analyzing the modes of transport for these trips - usually auto or transit.
- **Route assignment**
  allocating different modes of transport to a planned route and using various models to interpret how traffic patterns change.

This is paired with policy and with **land-use forecasting**, which tries to take into account factors such as population growth, employment, socioeconomics.

Where ICTs can help is in bringing insights that are otherwise expensive to capture



1. Mobile network data can be used to estimate origins destinations and to generate trips between them.

This is something that would otherwise require enormously detailed surveys.

Geographical distribution of origins to Colombo Fort, based on 2013 call data. D. Maldeniya, A. Kumarage, S. Lokanathan, G. Kriendler, K. Madhawa, "Where did you come from? Where did you go? Robust policy relevant evidence from mobile network big data", CPRSouth, 2015.

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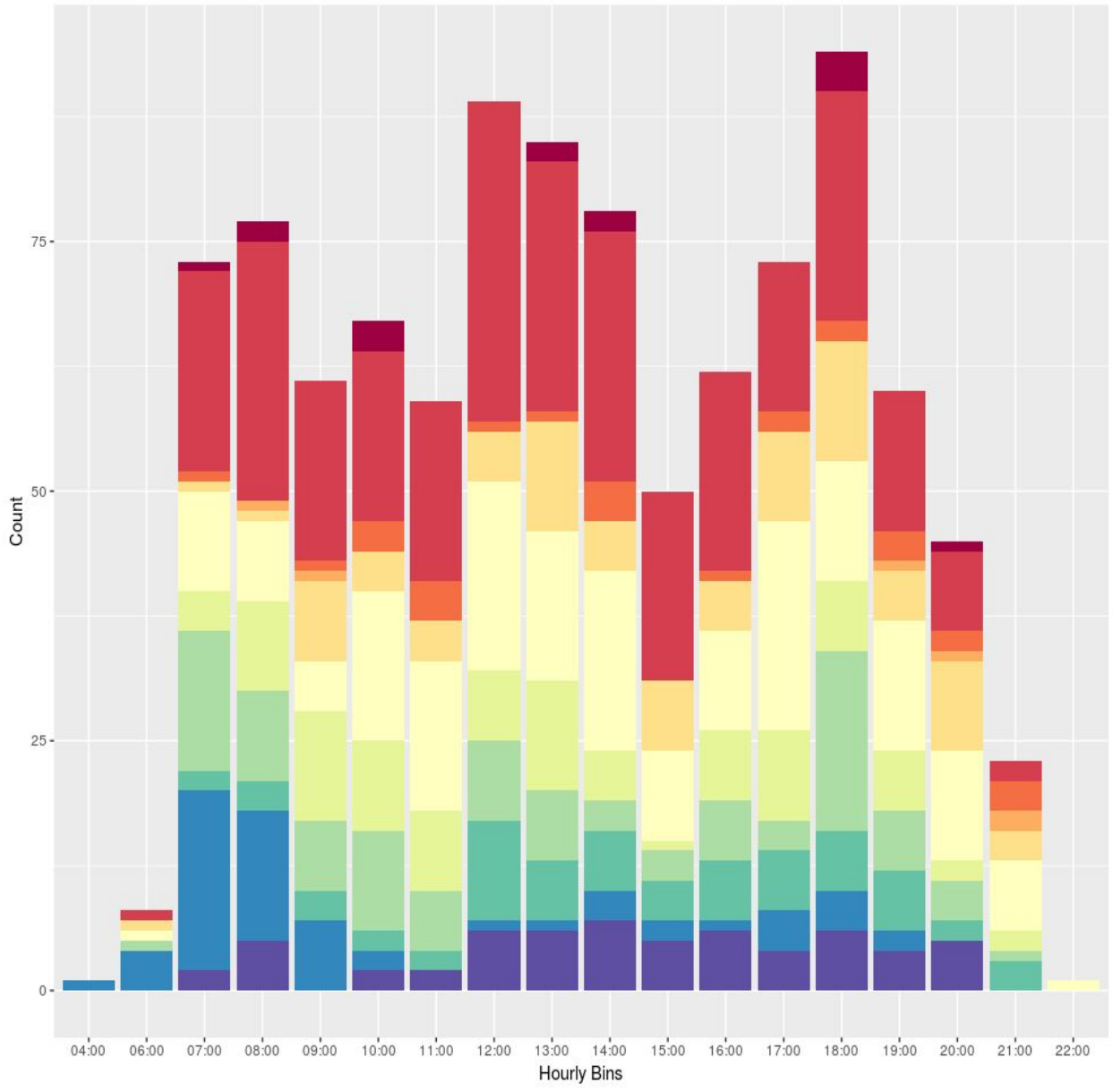
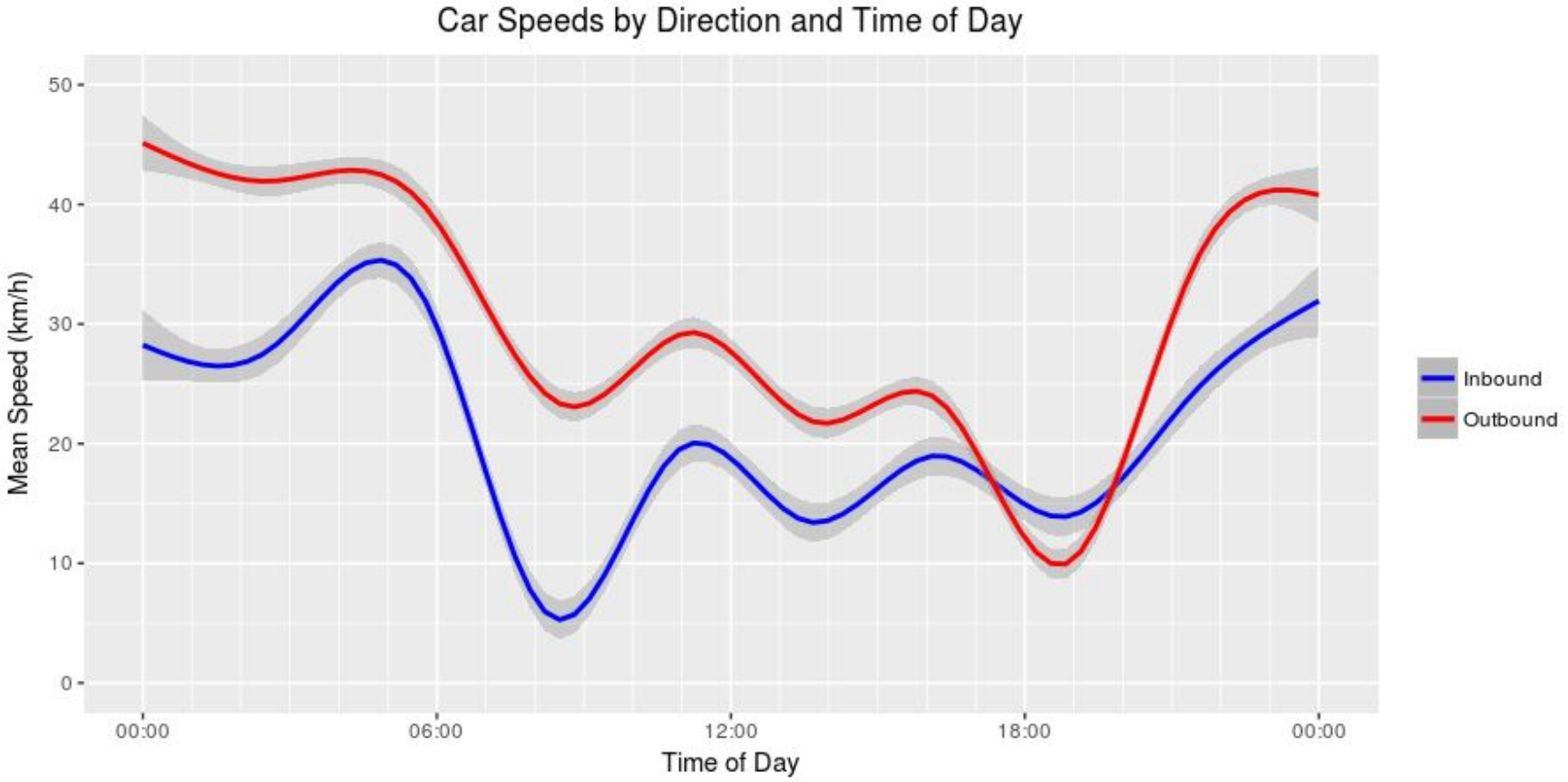


2. Smart survey applications that can collect GPS data while interacting with the user can describe the types of transport taken for these trips, by whom, when and what for.

Analysis of transport modes from (a non-representative sample) of over 9000 data points from 580 mobile phone users in Colombo. Data collection performed by an application over a period of time.

3. And finally, allow us to test the efficacy of proposed routes by analyzing speeds, times, and where bottlenecks form.



Traffic speeds during morning, afternoon and evening traffic peaks at the new Rajagiriya flyover. Source: two weeks of GPS data from a ridesharing corporation in Colombo.

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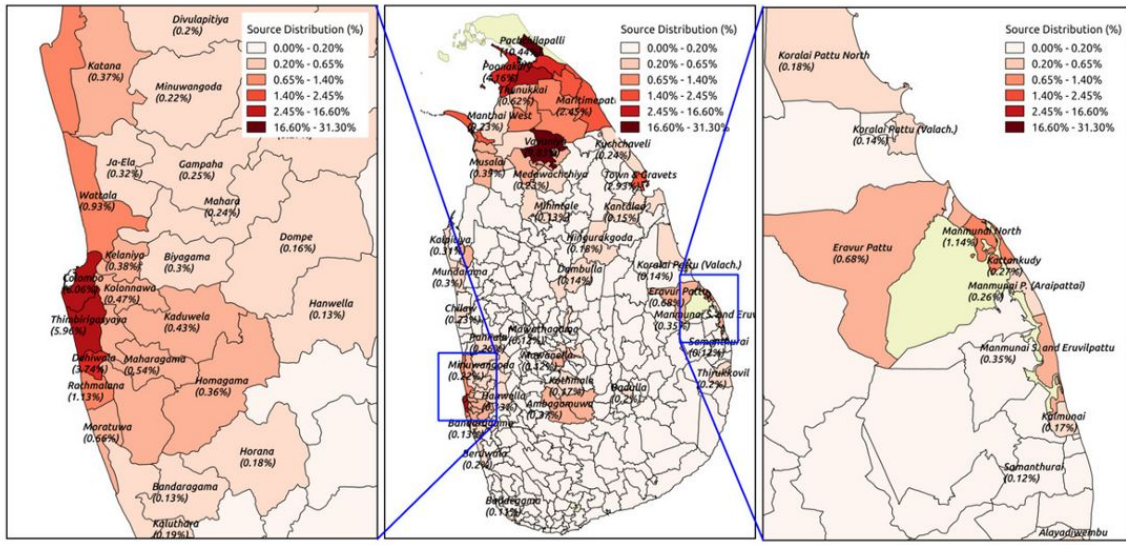
4. Big data can even aid in land use and population change analysis. And all of this can be done faster than with traditional sources of data (surveys) and over more frequent intervals.

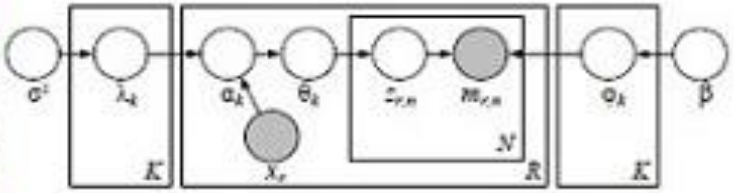
Figure 4: Expansion of Colombo city's Central Business District (CBD)

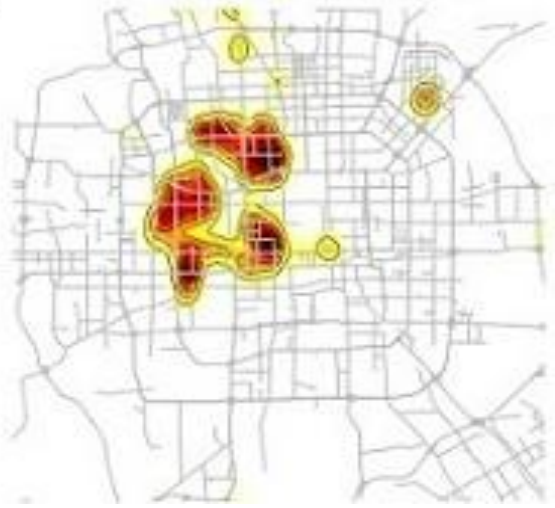
Using mobile network big data for land use classification, Kaushalya Madhawa, Sriganesh Lokanathan, Danaja Maldeniya, Rohan Samarajiva, 2015.

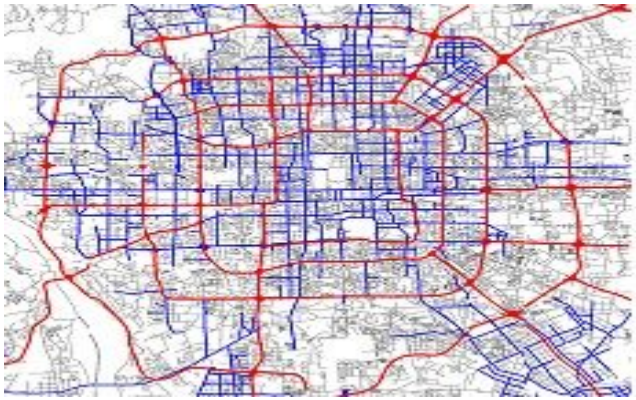


Using mobile network big data to analyze population inflow to Jaffna during the Nallur festival. The estimated origins of these visitors can shed light on the socioeconomic shift during that time.

transition cuboids ⟶ vocabulary
formal regions ⟶ documents
function of a region ⟶ topic of a document
mobility patterns ⟶ words
POI feature vector ⟶ metadata of a document







Slides from Microsoft Research.

ICTs can even tell us about emerging patterns and hotspots that we may otherwise not see and help us detect problems with existing road networks.

*Jing Yuan, Yu Zheng, Xing Xie. Discovering regions of different functions in a city using human mobility and POIs. 18th SIGKDD conference on Knowledge Discovery and Data Mining (**KDD 2012**).*

However, planning is only one component. Transport networks are dynamic.

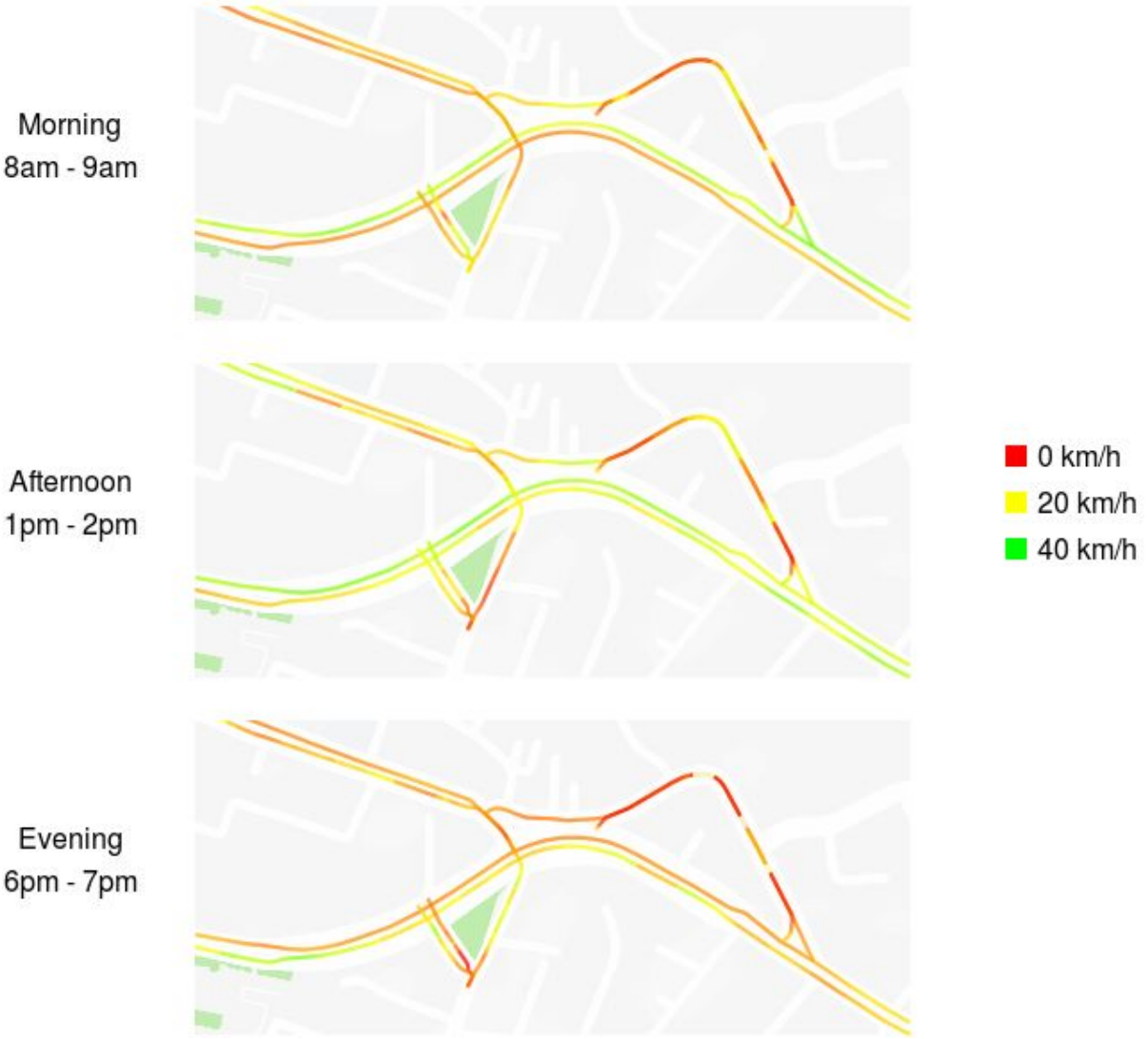
Transport requirements change: within the day and within the week; what we need when we're young and single, what we need when we have young families and what we need when we are old.

A key feature of being able to collect this data at scale and at greater frequency to enable continuous monitoring of how people use road and transport networks once they are built

The same analyses that helps to plan roads and transport can be run indefinitely.

Traffic patterns at different times on the new Rajagiriya flyover

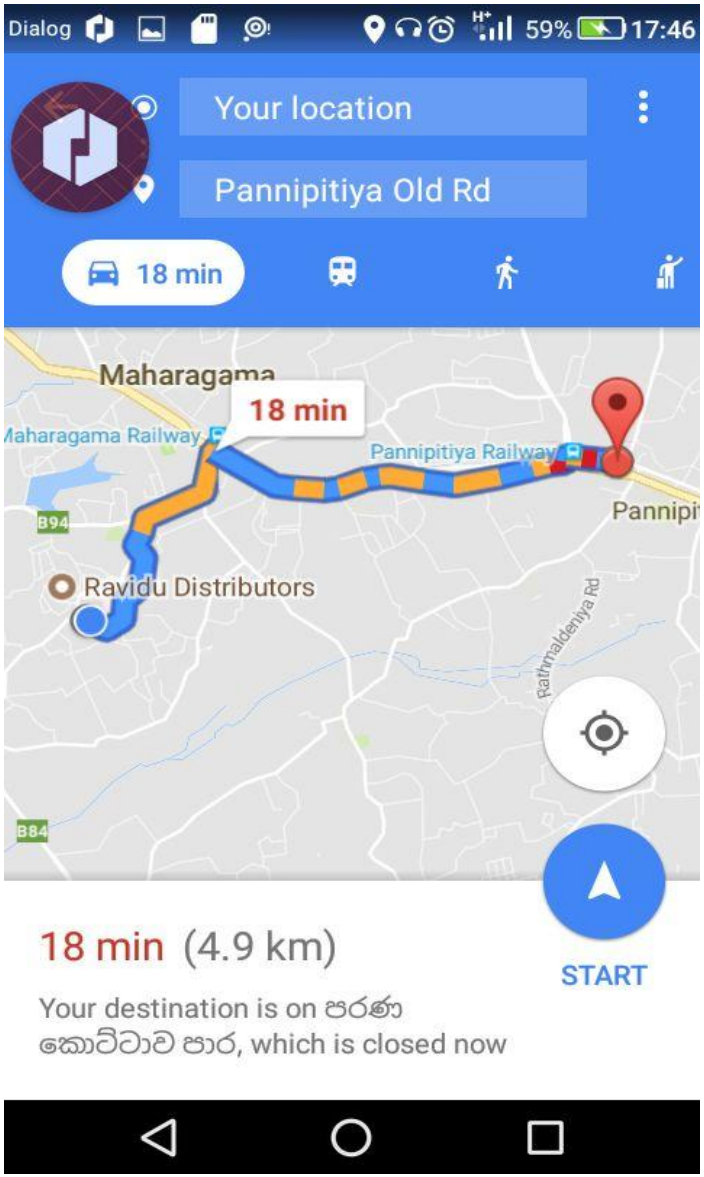
Traffic speeds calculated using three wheeler data during morning, afternoon and evening traffic peaks at the new Rajagiriya flyover. Source: two weeks of GPS data from a ridesharing corporation in Colombo.



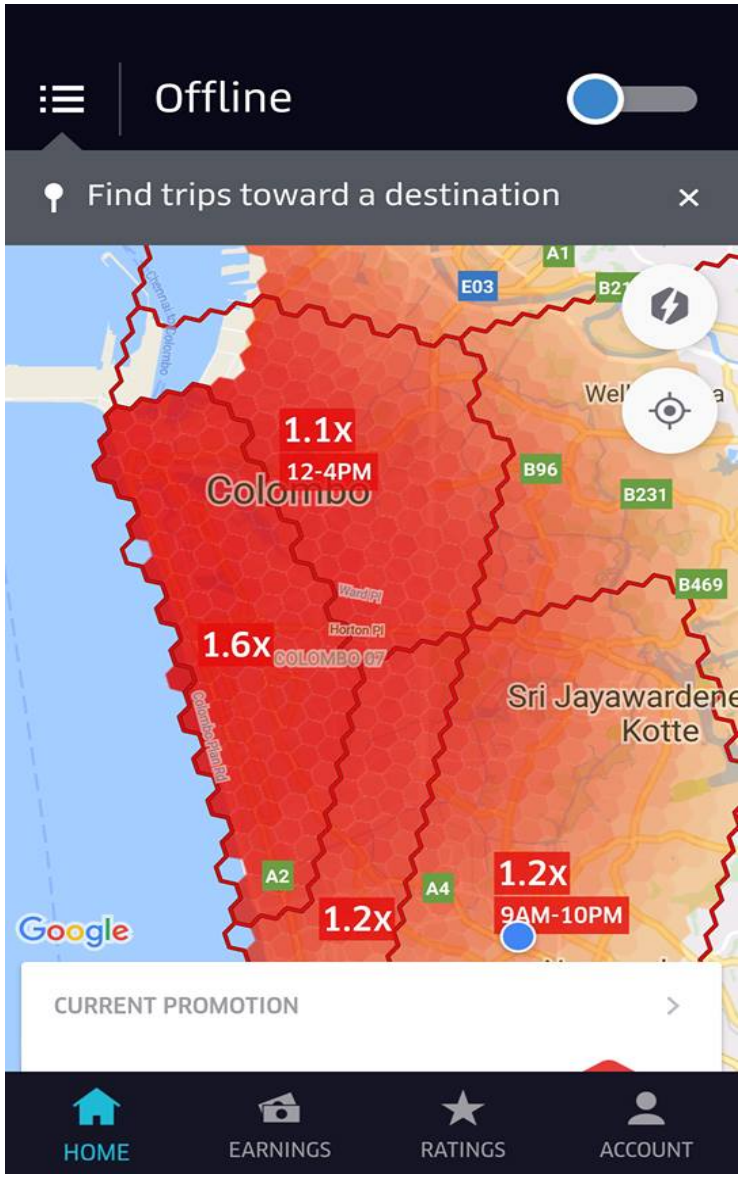
ICTs can help understanding, at greater frequencies, of changes in use patterns due to:

1. Seasonality
2. Breakdowns / disruptions in another part of the transport network
3. Changes in the behaviour of people in a given region
4. Emerging changes in the areas through which transport networks run

These can then be used to respond more quickly than previously thought possible.



Commercially, this technology is already available and these modifications are in play. Both consumers (the public) and suppliers (taxis) are changing their behavior based on traffic, road conditions, trip demand from a region, and time.



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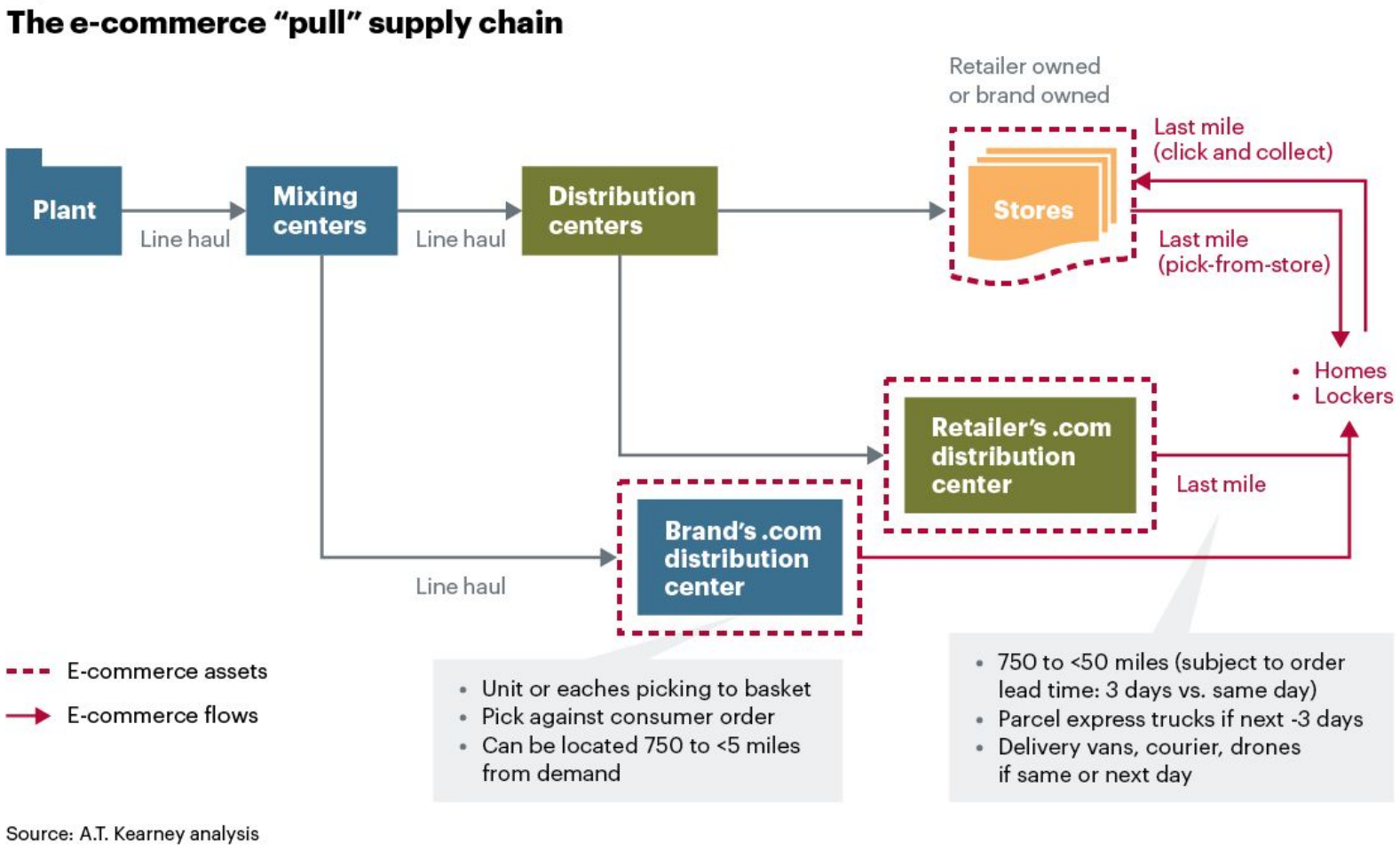
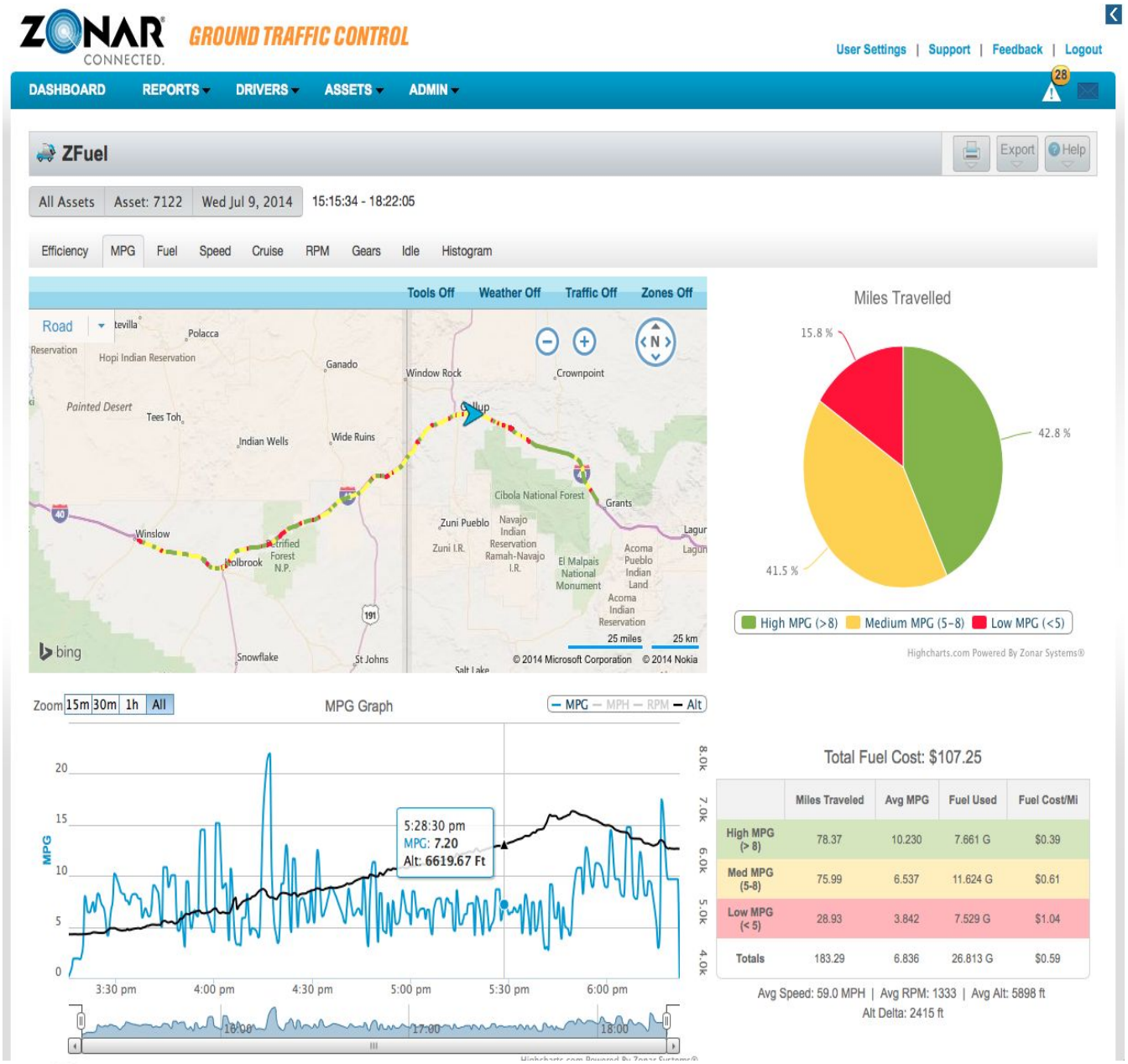
Online services change the utilization of transportation networks, and we can expect this effect to become more significant.



Source: A.T. Kearney analysis

Some will reduce traffic (e-banking etc), but some may add to the load at different points in the network.



Operators with big fleets are using big data from sensors to monitor everything from speed to fuel consumption. They then use this data for routing, to plan routes that are fuel-efficient, reduce wear and tear, and take the truck through states with the cheapest fuel prices.

Governments have traditionally been behind the curve.

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WSO2, at a hackathon for Transport for London, used data available from https://api.tfl.gov.uk/ and London's mesh network of SCOOT traffic sensors to:

1. Use historical data regarding the number of passengers at stations to predict how many people would be on a selected train or inside a selected station
2. Use Google Maps and combine that with sensor data from TfL sensors across the city to pick the best routes from point A to B, while predicting traffic, five to ten minutes into the future, so that commuters could pick the best routes
3. Pair air quality data from any given region and suggest safer walking and cycling routes for the denizens of Greater London

This allows the entire transport network to act as one integrated entity that can adapt and reroute traffic around protests, breakdowns, events, changes in user behavior.

Source: WSO2 Source blog, October 17th, 2016

The real disruption that ICT brings to the study of transport is that it brings the ability to constantly gather traffic data for both new and existing transport networks - allowing dynamic adaptation to transport needs, balancing of supply and demand, and management of congestion.

As governments and transport suppliers adapt, so do users. Usage patterns keep changing (peak spreading). Thus there will be a continuing struggle to keep the system in balance.