The New Mobility:

Using Big Data to Get Around Simply and Sustainably

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Without the movement of people and goods from point to point, the world economy would cease to flow and lifestyles would change dramatically. But familiar notions of transportation that have defined modern life for more than half a century increasingly are being viewed as unsustainable.

According to ITS America, in 2010 cars, trucks, SUVs, buses, motorcycles, and heavy-duty vehicles consumed 170 billion gallons of gasoline – enough for 1000 trips to Pluto --and emitted some 1.7 billion metric tons of carbon dioxide – by far the most significant greenhouse gas – into the atmosphere. In 2012 greenhouse gas emissions from transportation accounted for about 28 % of the US total, second only to the electricity sector. In Europe the percentages are similar; road transportation accounts for one-fifth of the European Union's total carbon dioxide emissions.

Transportation today largely depends on ownership of automobiles. Cars, which emit 30 percent of CO2 emissions worldwide, dominate cities and towns requiring constant investment in infrastructure. As the percentage of people that live in cities increases to more than 60 percent of the world population by 2030, traffic congestion and parking shortages can be expected to grow worse.

Given the importance of transportation to the world economy, how can this problem be addressed in a way that improves instead of diminishes quality of life? The development of cleaner alternative fuel sources represents an important long range solution, but does not address immediate problems such as congestion and parking shortages. Intelligent transportation systems, however, that apply data analytics to provide more efficient and sustainable transportation choices can make an impact today and create a foundation of sustainability for the future.

What is the new mobility?

Regardless of the availability of public transportation, millions of people in cities own automobiles. People spend thousands of dollars a year to purchase, maintain, fuel and park cars they use on average only 5 percent of the time. Because of that investment, most people feel compelled to use their automobile despite traffic congestion, parking difficulty, and fuel costs.

The new mobility is about giving people choices that make getting around easier, more convenient and sustainable. In the near future, mobility will be regarded as a service that integrates different modes of transportation seamlessly. Instead of tying up large amounts of money in a car that isn't used 95 percent of the time, for instance, you may subscribe to a service that allows easy access to public transportation, car sharing, and bike sharing through a universal payment system accessed through an app your cell phone. The goal is not necessarily to eliminate automobile ownership among city dwellers, but rather to provide attractive options to those who would prefer not to own a car, or would like to increase their mobility through easier access to different modes of transportation. Changing lifestyle preferences in younger generations support the concept of mobility as a service. In the last ten years, the number of people under 35 with a driver's license has decreased 6 percent while total vehicle mileage has decreased by 10 percent.

To attract subscribers and provide a viable alternative to automobile ownership, the mobility service has to be reliable, cost-effective and easy to use. That's where the power of data analytics comes in play. One backend system enables service providers – think bike share, car share, public transportation-- to transact with mobility subscribers on a single payment platform. The system collects valuable data that can be used to manage operations efficiently and customize services according to the preferences of individual users.

Mobility in Action: A Day in the Life of a City Dweller

The new mobility promises the sort of freedom of movement first associated with the automobile. Imagine Cindy, a city resident, has subscribed to the city's new mobility service.

It's now Monday morning and Cindy is headed to work. The mobility app on her phone, through which Cindy has specified her parameters for budget and timing, suggests the 7 am express train from Lexington Station to Central Square two blocks from her workplace. The weather report calls for blue skies and warm temperatures so her mobility app, which knows her preferences, recommends bike share for her commute home. She clicks yes on her phone and a bike is automatically reserved for her from the hub three blocks from her workplace. She puts her riding clothes in a small backpack and walks to the train station where she taps her phone at the turnstile to board the train.

 At the end of her workday, Cindy changes into her riding clothes and walks to the bike-share hub where her bike is waiting for her. From there she can ride along the dedicated bike lane –created by the city to encourage bike use – to the path that heads south along the river towards her neighborhood. She drops off the bike at the closest bike-share hub, which is right off the river path, and hops on a bus to take a 5- minute ride to the stop in front of her home.

That weekend Cindy decides to go to a soccer game in the city. The car pool feature on her mobility app notifies her that two of her friends also plan to go to the game and would like to share a car with her. The fee for the car share is automatically split among the three subscribers. Cindy's friend picks her up in the car and the app chooses a route based on how much they wish to pay for tolls and parking and how far they wish to walk to the stadium. They take the HOV express lane on the thruway, as they have three people in the car. From the thruway exit, the navigation system directs them to open parking spaces that meet their $10 budget and their request to be no further than a ten-minute walk from the stadium.

Lifestyle Benefits

Instead of limiting Cindy's mobility, not owning a car has increased it. Cindy's mobility subscription frees her from the expense and commitments of owning and maintaining an automobile. She has access to the most suitable travel mode for her life style and changing needs, and knows that she is also contributing to a better environment for her and her community. She has the added flexible mobility and control over the costs that new mobility bringsHer mobility service provides her with easy access to buses, subways and commuter trains and puts scheduling information at her fingertips.

The city, too, is transformed. Streets formerly difficult to cross because of the amount of traffic are more pedestrian friendly. Bike lanes now are possible and the air is clearer because traffic congestion has reduced considerably. The streets are no longer lined with parked cars so deliveries are easier for merchants. The city no longer has to spend as much money to build and maintain infrastructure for automobiles and is able to invest in biking lanes, paths and parks with pedestrian walkways.

A balanced approach to users and services

These new mobility services will emerge over time and as people appreciate the benefits they will increase in popularity. However, this is likely to be an evolutionary rather than revolutionary process, and many may still choose to own and operate their personal cars.

So, a balanced approach to providing services is necessary to be able to continue to provide the travel mobility people require. Clearly reducing car ownership in cities and providing easy access to a range of transportation modes will provide significant benefits for the users, the community and the still travelling by private car users. Even a small reduction in traffic provides significant efficiency, environmental and travel time reliability.

## Intelligent Transportation: How the system works.

Intelligent Transportation systems provide the essential platform for our mobility services. Intelligent backend systems encourage use of mobility by customizing services to the preferences of individual subscribers. With all modes of transportation services integrated into one payment system data flows to a centralized database or mobility transportation center. With advanced data analytics capability, the information gained can be used to improve services. A virtuous cycle forms: the greater the number of subscribers the more comprehensive and valuable is the information collected. The information drives service improvement that in turn attracts more people. Through analytics the data collected can inform subscribers choices regarding mode of transportation and the exact amount of time and money that trips require. It also helps the providers of services to predict usage and maintain the necessary supply of bikes, cars and public transport to meet demand in specific locations.

Xerox is helping shape our future mobility and is working with the University of Michigan on connected vehicles which will reduce accidents, improve information provision and be the cornerstone of these new mobility services. Connected vehicles will supply information about traffic congestion, accidents, and speed of travel in real time so the system can learn and make adjustments. Xerox also helps public transit agencies improve operations by applying data collected in digital systems. Applying advanced analytics and data visualization to determine how people use mass transit -- and why – provides city transportation managers with insight required to make route, resource and capacity adjustments. Bringing these disciplines together will power the new mobility services.

Intelligent Parking Systems

Intelligent parking systems can be used to decrease congestion and improve the enforcement of violations so more spaces open up. With sensors at city parking spaces the central mobility transportation center can lead subscribers to open spaces through the mobility app on their phone or through the vehicle's navigation system. By saving drivers from having to cruise for parking spaces – a practice that accounts for up to 30 percent of parking related congestion in cities – the system can eliminate a substantial source of congestion and pollution.

Concerned about the number of vehicles circling for parking spaces, the city of Los Angeles worked with Xerox to install dynamic pricing for on-street parking. Some 6000 sensors were placed on 800 streets in the city. Data analysis identifies over and under used spaces and pricing adjustments are used to better balance usage and to improve services. Prices were reduced at 60 percent of the parking spaces and increased at 27 percent. The system's dynamic pricing and communication with motorists influences the behavior of drivers by directing more of them to less expensive and underutilized spaces. The city maintains a dashboard overview that provides real time reporting for maintenance and enforcement. The city's parking revenues have increased by 2 percent, but more importantly, the popular system has decreased parking congestion – and pollution from cruising vehicles – by 10 percent. Parking space availability now ranges from 10 percent to 30 percent.
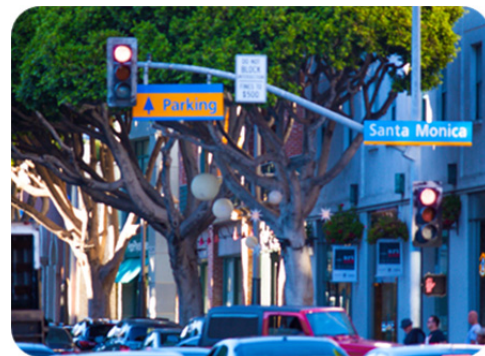
Use of Dynamic Pricing and All Electronic Tolling to Control Commuter Congestion

Traffic congestion on highways costs drivers hundreds of billions of dollars every year and contributes substantially to pollution by keeping cars running longer and increasing vehicle stop and start. Electronic tolling, such as EZ-Pass in the northeastern United States, serves to mitigate congestion by enabling commuters to pass through tolls without stopping their vehicles. The next generation of electronic tolling has been implemented in the state of Maryland where toll booths have been replaced eahby overhead gantries so that tolls can be collected from cars at highway speeds either from vehicle transponders or advanced license-plate recognition technology. In a city that offers a mobility subscription, electronic tolling many be offered for those who own automobiles or use car sharing services. Express lanes or High occupancy tolling (HOT) lanes may employ dynamic pricing – increasing rates when congestion is high – to improve mobility for commuters. Information on road construction, traffic congestion and journey times can be supplied to commuters.

Implementing Mobility Today

The technology to implement an urban mobility service exists today. Xerox has developed backend systems that enable electronic tolling, smart parking and open payment systems with contactless cards in cities throughout North America and Europe. In Montreal Quebec, one contactless card called OPUS allows passengers to access some 3,000 buses, five train lines and four metro lines and processes more than 1.2 million transactions daily. These services in Montreal are provided by nineteen different operating companies, but a single back office does all the processing while keeping each companies data safe and confidential for them. The next generation of backend systems will integrate new modes of transportation such as bike share and car share. At the same time, the system will serve several functions simultaneously:

- **Monitoring** from a centralized dashboard incidents, traffic congestions, air quality, capacity of roads, parking spaces.
- **Informing** subscribers about things that affect their mobility such as journey times, public transport arrivals, timetables and routes, road or highway congestion, disruption delays, incidents, road works, events, air quality and parking spaces.
- **Managing** variable toll charges, urban traffic control, low emissions zones, network management, freight management, photo detection and more
- **Performing Financial Transactions** necessary for public transport parking, tolls, and enforcement processing.

By making it easy for people to choose among different transportation options we can improve quality of life through greater mobility while making transportation in cities more sustainable.

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