digitalisation technologies
# Urban Mobility Services

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Digital technologies now affect almost every aspect of life. This alteration is already ingrained in mobility services in the form of information and communication technologies (ICT), which allows access to a copious amount of data for transport operators and users, and Mobility as a Service (MaaS), which delivers innovative solutions in mobility options, digital transport platforms and business models. These thriving technologies are pervasive and are driving the change in how transportation services are planned and operated and how people move in and around cities. Transport agencies and mobility leaders around the world are rushing to adhere to the new mobility trends in order to attract innovative economic development and to improve citizens' quality of life.

In this issue of *IGLUS Quarterly*, we look at the development and implementation of the technological advancements in different mobility cases around the world and how different strategies are now focused on utilising data to deliver inclusive and cohesive mobility plans.

In the first paper in this issue, Marco Martinez O'Daly explores the origins of what are now known as the SMART city principles. A study that identified the best practices of urban planning and development in Latin America and delivers a model that focuses on five strategic priorities, which are now a revolutionary bill in Mexico. Marco examines the importance and provides recommendations of each of the principles and their synergetic nature, particularly under digital platforms, which are currently substantial for urban development. Umut Alkım Tuncer explores the origins and advantages of smart cards use within the transport sector and delivers a detailed account of the evolution of the technology in two cases focused on megacities: Istanbul and Mexico City. In the following paper, Justin Hyatt examines how sustainable urban mobility plans (SUMP) are becoming increasingly important for managing resilient cities and for effective modal shift strategies, which are being significantly aided by ICT and digital platforms (MaaS). In the final article in the issue, Melissa Bruntlett and Chris Bruntlett offer insights into the role that e-bikes are playing to push cycling as a main mode of transport, and the different incentives cities are taking to facilitate the transition.

We hope you enjoy these four articles and we invite you to join the discussion at iglus.org. If you feel that there are innovative practices underway in your city/region and you would like to contribute to an upcoming edition of *IGLUS Quarterly*, we encourage you to contact us at diego.giron@iglus.org and umut.tuncer@iglus.org.

Diego Giron

# SMART Reform for Sustainable Mobility
# A Toolkit for Urban Economists, Innovators and Policymakers in the Digital Era

Marco Martinez O'Daly*

**Abstract:** *In 2012, a group of legislators and experts from Mexico embarked on a path to analyze and debate the challenges facing cities, tasked with finding policy solutions that could help alleviate the unsustainable increases in traffic, corruption, deteriorating infrastructures and public services, segregation, pollution, and other symptoms of the current urban crisis in Latin America. The group identified a set of best practices for new urban planning and urban development models, focused around five priorities for planning sustainable and inclusive cities in the 21st century: (1) self-financing fiscal strategies, (2) sustainable mobility strategies, (3) affordability strategies, (4) environmental resiliency strategies, and (5) technology and innovation friendliness strategies. These five principles came to be known as the SMART city principles, that shaped the urban reform bill that was enacted into law in Mexico in 2016 and is now reshaping every city in Mexico.*

A smart, sustainable city is not just about bus rapid transit (BRT) systems, some free Wi-Fi hotspots, electric car charging stations, or complex digital and ICT public projects. A city is not smart or sustainable if it is still characterized by manufacturing jobs or dying industries; if it floods every time it rains; if it faces impossible freeway traffic every day; if it witnesses deteriorating public infrastructures, water shortages, or increasing crime rates; or if it lacks cultural attractions, creative industries, entertainment, or architecture. We must begin to think of cities differently, as places where it is smart to live, which can be measured by their ability to attract and retain the most talented innovators, highly skilled labour, artists, athletes, startups, entrepreneurs, and investors. All cities around the world are in competition, and smart people and capital are constantly moving, rewarding cities with successful urban policies and abandoning cities with failed ones. Moreover, the cities that these most talented people and high-value investments move to also have the best opportunities for growth and betterment for the middle class and for the poor. Therefore, we must begin to understand smart, sustainable urban mobility, not just in terms of public transportation systems, but in terms of financial and residential mobility, in the ability for people to move to, and within, a city, in their ability to move up financially, and socially, and in their ability to live as close as possible to their preferred location, close to their places of work, of learning, of

playing. So, what is smart, sustainable mobility? What factor does technology play, if any? What challenges are all, or most, cities facing in the 21st century? What will be the most attractive cities to live in, in the near future?

In 2012, a group of legislators and experts from Mexico embarked on a path to analyze and debate these and other similar questions, tasked with finding the root cause of the current urban crisis, and identifying best practices for new urban planning and urban development models. After six years of extensive investigation and intense debates, involving some of the most renowned researchers, universities, entrepreneurs, land developers, mayors, and urban thinkers from Latin America and around the world, the group concluded its work with one of the most forward-thinking urban reform bills: the first nation-wide law of its kind, an idea that is now reshaping local governments and urban policies of every city in Mexico, rapidly spreading to other regions throughout Latin America.

The urban reform group found five smart policy strategies that can determine the success or failure of any given city: (1) self-financing fiscal strategies, (2) sustainable mobility strategies, (3) affordability strategies, (4) environmental resiliency strategies, and (5) technology and innovation friendliness strategies. These five principles came to be known as the SMART city reform princi-

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ples, based on the acronym for Self-financing, Mobile, Affordable, Resilient and Technology friendly.

First, strategies for smart fiscal policies must guarantee the financing of quality urban infrastructures and public services, roads, water, drainage, police, public transportation, etc. The group found that the issue of public services is always an issue of smart funding, budgeting, and pricing. The apparent problems of water shortages, crime, or even something as simple as increased potholes, must be recognized as a result of inadequate or irresponsible urban fiscal strategies.

Second, sustainable mobility policy must focus on reducing the average costs of transportation. This can be measured by people's average transportation costs relative to income, which must take into account all the different means of transportation. Furthermore, sustainable mobility must be assessed by the average daily time spent in traffic. The researchers found that the daily transport costs and time are a direct result of public space design and building regulations,[1] ranging from current low density, single-use zoning, sprawl models that focus on automobile mobility, to smarter mixed-use, high-density, interconnected street models that foster walkability and collective transport mobility.[2]

Third, affordability is a result of flexible zoning and business friendly regulations that allow for higher income levels and the lowest possible costs of living, especially housing costs. Housing affordability is impacted negatively by strict, low-density, single-family-style zoning regulations and, more positively, with flexible, market-driven density.[3] Most importantly, however, affordability is a direct result of the costs and barriers to starting and growing a business. This second factor determines the levels of competition, and therefore, the price levels for all products and services within a city, including housing, transportation, education, food, clothing, and entertainment. Cities with few or no barriers to competition result in significantly more small businesses, higher wages, and lower costs of living, for all people.[4]

Fourth, resiliency strategies must include a smart design for green infrastructure and environmentally friendly development regulations. Cities must be planned to withstand the great natural catastrophes that we know will occur every 100 or 500 years (or more often, if

the planet, continues to warm up). A city that cannot withstand a normal rainy day without major damage is doomed to fail, and a city's resilience is first determined by its ability to plan and protect certain key elements of the natural environment: rivers, lakes, beaches, streams, and swamps. These must be preserved against improper development in order to manage or harvest rainstorm water, high tides, or tsunamis.[5]

Finally, technology and innovation friendliness strategies mean having a regulatory framework that welcomes and celebrates global and local market-driven technological ventures and investments. This approach is related to what many cities today think of as "smart cities", but the approach is switched from government-led technological projects to market-driven technology openness. Cities whose citizens have access to use more smart technologies are cities that allow technology-led entrepreneurship and they are not necessarily linked to the level of technology used for government services.

Nevertheless, governments may use public-sector-led technology investments and innovations to improve each of the other strategies; for fiscal health, reducing the costs and increasing the quality of public services; for affordability, creating friendlier business environments through transparent and efficient, digital administrative processes, and through other such uses of digital tools.

Based on these five smart policy criteria for assessing cities, how smart are cities performing today? The answer is: not very well.

From a fiscal perspective, although cities today have some of the highest public budgets in history, more and more city governments lack funds even for basic public works, failing to provide adequate public services and sometimes even struggling to meet payroll. This a reality that is devastating the confidence on local governments, not just in cities from developing countries, but even those of the richest countries in the world.[6]

Second, most modern urban mobility strategies are failing. Cities are experiencing increasingly high levels of traffic, longer travel distances, disconnected and inadequate street networks that result in bottle-necks, zoning that separates all daily activities, and an increase dependency on one only method of transportation: individual

cars.[7] This model forces most people to buy and use a car, which increases families' financial burdens and results in greater loss of time in traffic each day, averaging over two hours a day, in most metropolitan areas. On the other hand, local governments attempt to alleviate traffic with even more car-oriented infrastructures, highway expansions, bridges, road bypasses, and excessively expensive projects that do not work.[8]

Third, cities are not thinking of affordability the right way. On one hand, cities impose a set of prohibitive land ordinances and development restrictions, zoning that limits building heights or density, and single-use zoning, resulting in higher costs of doing business and fewer opportunities for small and medium-sized businesses. This urban regulatory model results in a shortage of housing supply and, consequently, in an artificially high level of housing prices[9] that especially affects and displaces the poorest people in a city. Many cities have attempted to counteract this negative trend by subsidizing housing prices, or implementing rent controls, which has a negative fiscal effect, creates artificial housing shortages, black markets, informal settlements, and increases corruption.

But the situation is not just about housing; it is about every other product and service whose price is affected by a city's uncompetitive regulatory framework: education, food, clothing, health care, recreational activities, art, entertainment, and so on. It is also about the job market: the more small and medium-sized business open up in a city, the more and better employment options there are.[10] The downside, however, is reduced housing supply and business friendliness, lower wages, and higher costs of living.[11] The problem is that all cities are currently being planned under inflexible, low-density, car-centric models, and have ridiculous bureaucratic processes for legally launching small or medium-sized businesses.

Fourth, there is an increasing resiliency crisis exposed through recent storms and floods that have devastated entire cities due to inadequate urban planning, not just in Latin America but in the United States as well. Most cities face chronic stresses from yearly rains that exceed their rain water management infrastructures. Then there are the once-in-a-lifetime storms and hurricanes. Planning a city to withstand these most predictable issues should be urban planning's foremost requirement, but hurricane after hurricane exposes the failure of cities to plan resiliency adequately.

Finally, instead of welcoming technology, many cities have decided to confront innovation with hostility, attempting to preserve old, outdated industries and power structures. The digital era is reshaping every industry in the world, and one of the most game-changing phenomena it has brought about is the sharing economy platforms that are creating new, unprecedented opportunities for small and medium-sized businesses, but, most importantly, empowering individual consumers like no regulation had ever done before.

However, these technologies are also rendering old industries, corporations, unions, and regulators worthless, faster than ever, resulting in protests, marches, lobbying, and opposition from many special interest groups that are fighting to preserve dying industries and traditional power structures. That is why dozens of cities have banned platforms like Uber and Airbnb or why many have enacted prohibitive regulatory barriers to these and other digital platforms that have transformed and will continue to transform the way we move, communicate, live, work, play, and exchange in cities across the world.

The only questions are: How long will any given city wait before deciding to ride the wave of the digital era's transformation? And if it waits too long, will it then be too late to survive?

### Policy recommendations

First, smart city policy should focus on sustainable fiscal mechanisms, using value capture mechanisms, and neighborhood–led participatory budgets, allowing public works and public services to be self-financed. Cities and neighborhoods should charge for public parking and street vendors. Property tax rates should be defined according to the cost of public services and infrastructure maintenance. Cities should define participatory budgets for neighborhoods, where property owners of each district define the yearly investment priorities. Cities should also create urban infrastructure investment funds that require property owners to fund infrastructures that will benefit them directly, while ensuring that these resources are reinvested in more and more infrastructure, not misused in bureaucratic expenses that do not truly contribute to land value and development.

An important policy strategy must be to charge all ur-

ban services using market value mechanisms in order to guarantee quality, sustainable services. This means that water, trash collection, street lighting, and other public services must be charged according to its market value, not at a net operating loss. Cities with water shortages must have more expensive water, and that is a very important signal that needs to be communicated to the global market, lest a city without water grows itself to destruction. Of course, these market mechanisms can be complemented with social safety nets, allowing poor neighborhoods to receive social subsidies and allowing people in the poorest brackets to receive some social assistance for basic public services, as long as these social subsidy budgets do not get mixed with the infrastructure and public service budgets. These strategies are easier than ever today through the use of technology and digital tools.

Second, streets must allow higher-density, mixed-use, compact cities, planning for highly connected street grids, that prioritize pedestrian, cycling, and public transportation infrastructure, regulations, and investments over automobile ones.[12] This must be done first by preparing land for urban expansion before development begins, with the necessary design of streets and location of key public works. Furthermore, streets need to be designed with transport-oriented development guidelines.

However, a key mindset and policy guideline for sustainable mobility in cities needs to be placed on residential mobility. To help people reduce the distance of their daily commutes, they must be allowed to live closer to where they want to live, to move once every 10 years, or every time they change jobs, instead of having to commute daily. This is both an affordability issue and a cultural issue. With the failure of the 20th-century urban development model, many communities bought into the idea of single-use zoning and single-family home neighborhoods, where they would grow old and retire in the same house. The world learned of the failure of this model, not just because of its destructive urban and economic side-effects, but because people kept moving anyway, now averaging over 11 shifts in their lives.[13] Either way, some of these communities became entitled to that zoning exclusivity promise, fighting against new developments, especially against affordable housing. Having hoped to live in the same house their entire lives, they become NIMBYs ("not in my back yard"), causing

more sprawl and costlier housing and development for entire cities. We must end this zoning mindset, returning to the historical knowledge our ancestors had about the conditions of living in a city, before zoning was invented: cities will, and must, evolve.

Third, cities must revise all their local regulations and land ordinances to focus on maximum affordability. This requires making room for orderly expansion. The more land a city has available for development, the lower the cost of housing. It also requires flexible zoning regulations and construction restrictions that allow more market-driven creativity, more housing diversity and options. We must also reduce barriers for all kinds of businesses, investments, and startups, especially for small and medium-sized local businesses, and even for large foreign direct investments, and corporations.

This step also means reducing the transaction costs, times and processes for all permits, health permits, transportation permits, construction permits, zoning permits, land development permits, as well as every license and legal authorization required to open any type of business. However, in order to avoid losing public support for such flexible, business friendly visions, cities would be well served to define a list of the few high-risk industries they will place stricter limits on, industries that are particularly worrisome to some communities for historical or cultural reasons, such as casinos, night clubs, gas stations, schools, and daycares.

Fourth, cities must have a long-term, green infrastructure strategy in order to guarantee the environmental resiliency of their city. Again, this implies preparing land for expansion, defining key projects to preserve rivers, lakes, swamps, beaches, and all other natural areas, especially those that will be indispensable for resiliency during extreme weather-related events. It is important that cities turn these areas into parks to avoid the temptation of future mistaken authorizations or illegal developments that can put an entire city at risk.

Finally, cities need to ride the digital era wave before it is too late. First and foremost, this means celebrating entrepreneurs and allowing, welcoming, and promoting the arrival of all sharing economy platforms possible. Secondly – and only secondly – it means using digital and technological tools to improve the quality of public services and of information gathering that can allow

public officials to make better decisions for infrastructure and public service needs. The problem with public sector innovation and investments, especially with some public private partnerships, is that they require exclusivity and protection against competition in order to operate properly. While this idea may seem like a good investment at the time, the price of technology is changing at an unprecedented pace and new, even free, technologies may render an investment obsolete. This is a problem because if an investor, or if the government, invested in a long-term solution, it will fight off the lower-cost, better, solutions, as long as it can.

There is a wave of creative destruction reshaping every city in the world today. The digital era has brought unprecedented opportunities for urban entrepreneurs, and cities must decide which of three paths they will choose. The first two options are that they will either be early adopters, and surf the wave towards success, becoming one of the most attractive, smart cities in the world; or they may choose to let others paddle first and attempt to ride the wave a little too late to win the game, but still in time to survive. The final option – and one that many cities are betting on – is to try to stop the wave or skip it. Like the cities that fought off the automobile in defense of their horse industries, or the ones that fought off the internet in defense of their telegraph workers, there is no stopping a global revolution as powerful as the digital revolution; cities can either be smart about it, or not.

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# The role of technology in public transport integration and governance – smart card use in Istanbul and Mexico City BRT systems

Umut Alkım Tuncer*

**Abstract:** *Technological developments in recent times have had a transformational effect in many business sectors and processes. Some conventional methods in production and services have been abandoned, making way for innovations and new collaborations among actors. The public transport sector, which is generally regarded as non-profit, has had its share of these technological advancements. Driverless and electric vehicles, smart applications for passengers, and big data to be used by public transport operators are some examples.*

*One output of the technological revolution is the smart card payment system, which has achieved widespread use around the world, as it is convenient for passengers and a reliable fare collection method for public transport operators. While technological advancements change the way services are offered, it also brings out new opportunities and governance structures. The smart card has had this effect within the public transport sector because it facilitates the non-physical integration of different urban transport modes and changes the conventional governance structure by bringing technology providers or finance sector representatives into the picture.*

*This study examines the relations among different stakeholders in Istanbul and Mexico City bus rapid transit (BRT) systems and then focuses on the effect of prepaid smart cards (the istanbulkart and Tarjeta del Distrito Federal, respectively) on improving the logical integration of BRT routes with other modes in these cities.*

## Introduction: Digitalization, Smart Cards, and Public Transport

Starting in the 20th century and gaining momentum in the last decade, digitalization has affected our lives in many ways and transformed conventional business methods in all industries. This study focuses on the public sector and particularly on public transport.

Public transport's importance is very much related to the global urbanization trend. Concepts such as the "smart city," "digital city," and "intelligent transport system" (ITS) have become popular for local authorities and among scholars who carry out urban studies. Nevertheless, there is not a consensus on the exact definitions of these terms (Garau, Masala, and Pinna 2016, pg: 35), and it can be argued that this is due to the high speed of the development of digitalization processes in cities. Digitalization has had an impact on cities assets, people, economy, local governance, environment, and mobility, to mention a few (Navarro, Ruiz, and Peña 2017, pgs: 272–273; Benevolo, Dameri, and D'auria 2016, pg: 15). The recent and fast-spreading popularity of the word "smart" in an urban context is largely due to digitalization's potential in developing city conditions. Today,

cities face various problems such as traffic congestion, environmental pollution, and high energy consumption, and many believe that smart city initiatives can help eradicate or mitigate these problems. These initiatives can be beneficial in improving mobility with intelligent traffic systems, decreasing the environmental impact of transportation via smarter solutions (Garau, Masala, and Pinna 2016, pg: 35), enhancing participatory governance through new digital instruments (Yeh 2017, pg: 1), increasing energy consumption efficiency by software- and hardware-based optimization studies (Navarro, Ruiz, and Peña 2017, pgs: 272–273), and ultimately creating better living conditions for urban dwellers, who will constitute 70 percent of the world population in 2050 (Lyons 2016, pgs: 1–3).

Within the scope of this digitalization trend, the public transport sector and its business processes have also had their share of digital upgrades, and today improvements in infrastructure can be seen, vehicles, and connectivity between assets. An important component of public transport, payment systems – or in business language, the "revenue management" aspect of public transport – have made use of new technologic products such as

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smart cards and the related infrastructure such as turnstiles and in-vehicle validators among others. The study examines smart cards' origin and their advantages for public transport, and then analyze their implementation in our case studies by using the alignment framework.

*Smart Cards*

Although the smart card is a popular topic in the public transport literature, it is not a new technology, as it originated in 1968, became widespread after the 1990s, and was adopted by the French postal, telephone, and telegraph services and the German healthcare sector as early as 1982 and 1992, respectively (Pelletier, Trépanier, and Morency 2011, pg: 557). In terms of technology, these cards are divided into two broad categories: closed-loop and open-loop cards. Whereas open-loop cards can be processed through a bank network and used in credit card schemes such as Visa and MasterCard, closed-loop cards do not have this option, and closed-loop card users have a formal relationship only with the agency that issues the card (Smart Card Alliance 2011, pg: 6). The smart card is perceived as a secure payment method by agencies (Pelletier, Trépanier, and Morency 2011, pg: 558), and consumers perceive the cards as convenient to use because they can be obtained through various channels such as websites, self-service kiosks, retail stores, and the offices of issuing companies or institutions (Smart Card Alliance, pgs: 7–17).

*Smart Cards and Public Transport*

Since their introduction to the market, smart cards have evolved, and now there are different types, such as payroll cards, gift cards, general purpose cards, and flexible spending account (FSA) cards, not to mention closed-loop travel cards (Smart Card Alliance, pg: 10). Travel cards which replaces cash payments in vehicles have been in use for some time now and allow transportation agencies to replace paper tickets, the conventional method of payment in public transport (Lovrić, Li, and Vervest 2013, pg: 1590). In an academic sense, this technology, its use, and its effects on urban transport have generally been studied within the recent concept of smart mobility, which is regarded as a sub-topic of smart cities. Smart mobility discussions very much center on notions such as the safety, sustainability, efficiency, effectiveness, and environment friendliness of transport systems (Benevolo, Dameri, and D'auria 2016, pg: 16), and the smart card system is often regarded as an application associated with smart mobility within the context of urban transport systems (Garau, Masala, and Pinna 2016, pg: 37).

Abandoning conventional methods and adopting smart card systems for revenue management in public transport systems can bring several advantages. As shown by the related literature, the most discussed advantages are the data generated by smart card use, its convenience (a customer-oriented look), fare collection efficiency (a transport agency–oriented look), and transport integration.

Regarding data, smart card data has good potential to improve transport services. Agencies can learn about the travel behaviour of passengers and do demand forecasting by origin and destination data and the frequency of passengers' use of a given mode of transport (Lovrić, Li, and Vervest 2013, pg: 1590; Alsger et al. 2016, pg: 490). This data can provide hints to agencies about the reliability of the service provided, the modal transfer behaviour of passengers, and the variability in demand for the transport options (Kim, Corcoran, and Papamanolis 2017, pg: 147; Cho et al. 2015, pg: 708). Consequently, this data can help agencies enhance their capacity in terms of service planning.

Smart cards eliminate the use of cash payments, and even if there is an adaptation period it has been proven to be more convenient from the user perspective. No cash transactions occur between users and bus drivers or agency representatives at stations because tapping the card on a reader causes payment (Pelletier, Trépanier, and Morency 2011, pg: 558). Public transport therefore becomes more self-operative, and the operational risks arising from the human element can be reduced. Moreover, without the cash transaction, overall trip time for passengers decreases, making public transport more appealing. Agencies began by implementing a pre-boarding smart ticketing infrastructure in rail-based systems; the success of this method is evident, as agencies are now implementing it in other modes of travel, such as bus rapid transit (BRT; BRTData 2017).

From a public transport agency's perspective, smart card use guarantees more secure and accurate fare collection because there are no longer human intermediaries in the collection system. The agency collects fares directly from customers without drivers or ticket officers handling a cash transaction. Thus, smart cards are more reliable and also decrease labor costs related to collection (Shield and Blythe 1997, pg: 258). This argument becomes more significant when it is taken into consideration that, without smart cards, transport agencies generally spend 5 to 15 percent of their revenues on fare collection and fare processing (Pelletier, Trépanier, and

Morency 2011, pg: 562). Agencies can also benefit from being part of a bigger public sector payment network (if there is an existing smart card mechanism in the city they serve), which may increase their revenues (Meyer and Shaheen 2017, pg: 129).

Another advantage discussed in the smart card literature is transport integration. Generally, transport integration is regarded as a tool for promoting a mode shift from unsustainable transport options such as private cars and motorcycles to public transport, because it makes the whole public transport network in a city more accessible and convenient to use by decreasing travel times (Preston 2010, pg: 332). Transport integration is a broad subject, as it may refer to integration of transport infrastructure, integration of transport authorities, integration of policies, modal integration, social integration, etc. (Potter and Skinner 2000, pg: 282; Preston 2010, pg: 330). In this study, the integration of fares and fare collection infrastructure is the relevant point.

In theory, smart cards can integrate the payment procedure in public transport modes and other elements in terms of mobility, such as bike sharing, parking, toll roads, bridges, and tunnels (Meyer and Shaheen 2017, pg: 122). This integration can bring flexibility for passengers and encourage public transport use by increasing its competitiveness among other options (Turner and Wilson 2010, pg: 170; Solecka and Żak 2014, pg: 260). Today, there are examples of such integration on the local and even national level. Whereas "Carte Orange" in Paris and "Oyster Card" in London are local integrated smart ticketing applications, "OV-chipkaart" in the Netherlands and "Octopus Card" in Hong Kong are national-level applications (Potter and Skinner 2000, pg: 282; Turner and Wilson 2010, pg: 173).

The literature shows, this payment system can be an instrument for improving existing transport systems. Most studies examine smart card data, its convenience for users and agencies, and its role in transport integration, but not much has been reported on how this system develops in cities. Therefore, this research focuses on; what are the underlying processes that lead to smart card payment system development in cities? To answer this question, the study focuses on the smart card used in the city of Istanbul, istanbulkart, and on Mexico City's Tarjeta del Distrito Federal. Information on BRT systems in these cities will be provided to aid in understanding smart card system development. Both of these cities are in developing countries and can be regarded as "megacities" due to their scale of population

(Britannica Encyclopedia 2017; ICVB 2017). Moreover, they have similar public transport options for passengers (Britannica Encyclopedia 2017).

## Istanbul

Istanbul has a population of 14.8 million people and is the economic center of the Republic of Turkey, a country with a unitary form of government (TSI, 2017). Municipalities are the authority responsible for urban public transport, and the corresponding body for the city of Istanbul is the Istanbul Metropolitan Municipality (IMM; Tuncer 2016, pg: 30). IMM fulfils its public transport responsibility through affiliate companies and authorities working under it, such as IETT, Metroİstanbul, Şehir Hatları A.Ş., and Otobüs A.Ş. In addition, it licenses private operators that provide public transport service (Tuncer 2017, pg: 38). Historically, paratransit modes such as dolmuş (minibuses), taxis, and shuttles have dominated Istanbul public transport, but with government investments in railways and buses, these paratransit modes' overall share has decreased (Tuncer 2016, pg: 29).

The smart card used in Istanbul's public transport system is called "istanbulkart"; this smart card system was developed in 2009 (IETT 2014). However, in Istanbul, integrated ticketing was already in place with coin shaped "Akbil," a touch on memory (TOM) button; this system had been taken into service in 1995 (IETT 2014). The Akbil system was developed by the tech company BEL-BİM, one of IMM's 30 subsidiary companies, established in 1987 (IMM 2017; Webcitation 2017). A lack of coordination among different transport agencies, their inability to gather transport data, and costs related to paper tickets and coins are credited as the cause for the development of the Akbil system (Webcitation 2017). Moreover, studies argue that, in addition to integrating the fare system, Akbil was implemented to eradicate fare evasion, which affected up to 5.8 percent of all public transport trips in the city (İskefli 2009, pg: 67). After initiation, Akbil integrated 17 different payment media of 11 different agencies, and its successor, the istanbulkart, can be used at 17,000 points in Istanbul, including buses, underground metro, BRT, maritime modes, cable cars, trams, toilets, parking, and municipal restaurants (istanbulkart 2017).

Istanbul has a 52 km long BRT route. This fully dedicated BRT route (except the section on the 15th of July Martyrs' Bridge) is called Metrobüs, has 44 stations, and is operated by IETT, a public institution working under

IMM. The system has a peak frequency of 156 buses in an hour (BRTData 2017). This BRT project was completed in four phases, and the first part of the route was put into service in 2007. Passengers paid their fares with Akbil at first, and after the istanbulkart was developed, Metrobüs was integrated with this payment scheme.

In contrast to the flat fare approach of other public transport modes in the city, Metrobüs has a distance-based fare. Passengers tap their cards at turnstiles while entering the system, and the full amount is deducted from their cards; if they do not travel the whole route, they tap their cards again at their exit stations to get their remaining amount. The minimum fare is 1.80 TL ($0.29 USD; for travel from 1 to 3 stations), and the maximum is 3.55 TL ($0.58 USD; for travel past 40+ stations). In addition to istanbulkart, passengers can buy electronic, paper-based tickets for single, two, three, five, and ten public transport trips, but this costs more, as a single trip ticket is 4 TL ($0.65 USD; Metrobüs 2017; Tuncer 2016, pg: 35).

## Mexico City

Mexico City is the capital of Mexico and has a metropolitan population of nearly 21 million (indexmundi 2017). Mexico has a federal form of government, and there are 31 states. Mexico City, however, is not part of a state; the area where the city is located is called the Federal District or Distrito Federal (Tuncer 2016, pg: 36). Public transport is the responsibility of the Mexico City Municipality (the authority tier after the Distrito Federal) and also of other neighboring local authorities within this wide urban area. The Mexico City Municipality either provides the service itself or licenses private operators to do so. The Municipality has a division called Secretaria de Movilidad (SM), and this secretariat has public transport departments called Sistema de Transporte Colectivo (STC), Servicio de Transportes Eléctricos del Distrito Federal (STE), and Red de Transporte de Pasajeros del Distrito Federal (RTP) for the management of different modes of urban transport (Tuncer 2016, pgs: 39–40). Mexico City, as with Istanbul, has had more paratransit options than higher-capacity systems, but initiatives to reverse this trend have occurred in recent decades due to increasing traffic congestion and decreasing air quality (Tuncer 2016, pg: 38).

The public transport smart card used in Mexico City is called Tarjeta CDMX or Tarjeta del Distrito Federal (TDF). Developed by the Municipality, it came into operation in 2012 and was intended to integrate the dif-

ferent payment methods in the metro, BRT, and light rail (CDMX 2017). Today, TDF integrates the underground metro, light rail, trolleybuses, buses, BRT, and the bike-sharing program called Ecobici (Milenio 2014). Before this smart card, there had been other attempts to develop a fare collection system. Historically, paper-based magnetic stripes and e-tickets were also used (Universidad Iberoamericana 2015, pg: 27).

As for BRT, Mexico City has a network of 125 km with six lines, and there are 1.1 million daily passenger trips on average (BRTData 2017). The system has a peak frequency of 77 buses in an hour (BRTData 2017), and BRT lines are managed by RTP and the "Metrobus" public company set up for this specific purpose. Existing private companies provide most of the service inside the routes and receive kilometer-based remuneration; these companies provided public transport service before the BRT, and they consolidated to form the new system (Tuncer 2016, pg: 42). The first line of BRT began in 2005, and other lines were put into service in 2009, 2011, 2012, 2013, and 2016 (BRTData 2017). After the TDF smart card was released in 2012, the BRT network was integrated into this payment scheme through a renewal process in the fare collection infrastructure. Passengers can still use the previous payment card, called Metrobus. Similarly, on the metro, passengers can use TDF or the Metro card that was developed before the integrated TDF method was devised (CDMX 2017).

## Analysis

The previous section presented an overview of the development process of the public transport smart card systems and their function within the BRT systems in Istanbul and Mexico City. This study analyses these cases using an alignment framework, or, as it is sometimes called, a coherence framework. This framework has its place in the co-evolution between institutions and the technology literature, and in a broader sense, it has its roots in New Institutional Economics. Co-evolution in our context is defined as "the two-way and long-term interaction patterns between companies and their environment, capturing both adaptations to, and more active influencing of, institutions" (Dieleman and Sachs 2008, pg: 1274).

Elaborating on the co-evolution literature, the alignment framework puts forward that institutions co-evolve with technology, and this, in turn, affects the technical, social, and economic performance of infrastructure systems (Finger et al. 2010, pg: 7). In addition, "innovations

are acknowledged to happen as a result of interaction between institutional, technological and market actors, when institutions and technology are misaligned" or incoherent (Audouin and Finger 2017, pg: 7). So, to have infrastructure systems (including BRT) that perform well, institutions and technology need to have some sort of coherence.

Looking from a coherence perspective, it can be noted that institutions (IMM and CDMX) and technology (the public transport smart card) are aligned in both cases, because the istanbulkart and TDF systems were developed by the institutions themselves. Also, IMM setting up a tech company (BELBİM) for this kind of project implies technology's influence on institutions. Moreover, the technology has become a tool for these institutions in their attempts to decrease the dominance of existing paratransit modes. Istanbul attempted to integrate the fragmented payment system, gather transport data, and decrease fare evasion with Akbil TOMs as early as 1995, and Mexico City already used e-tickets and not integrated smart cards before unifying the payment system with TDF in 2012.

The two cities had similar experiences, to some extent, with BRT systems. Istanbul had already applied an integrated payment system before the BRT, and istanbulkart was integrated into this scheme. Mexico City, on the other hand, issued a smart card to be used at BRT at first, and when the TDF project was completed, the BRT was integrated as well. The institutions became more active, and the smart card technology enjoyed more widespread use with the enlargement of the public transport systems with BRTs. And, without the smart card technology and pre-paid payment systems, these BRT systems would not be able to achieve the operational performance they now have (156 buses an hour in Istanbul's BRT system, for example). Without the technology, passengers would need to pay their fares or tap their cards inside vehicles, which would increase the dwelling times of buses at stations. In addition, the distance-based payment scheme in Istanbul's BRT system (the tap in and tap out method) and Mexico City BRT's fare collection, where operations are mostly private, would be problematic without the technology.

## Conclusion

Technology and institutions can have a relationship that results in a win-win situation, as seen by the institutions studied here, which made use of smart card technology to support their local policies to improve the efficiency of public transport systems and reduce high paratransit use by citizens. Ultimately, smart cards extended their reach to larger masses. Proper use of technology can be a requirement for infrastructure systems such as BRT, rather than a service improvement option, because use of technology (such as pre-boarding payment and the check-in and check-out method for distance-based pricing) can be crucial in securing operational speed, a prominent feature of these systems.

As stated often in the smart city's literature, technology transforms the way services are offered to citizens, but it also requires new governance mechanisms, special coordination methods, or special business models (Díaz-Díaz, Muñoz, and Pérez-González 2017, pg: 198; Walravens 2015, pg: 223). The alignment framework that is used in our analysis also supports this idea, as do the cases studied here, as IMM set up a company to develop technologies, and Mexico City established a separate company to run BRT operations.

Local institutions in the cases studied here are now integrating other city services to the smart card payment scheme; istanbulkart can now be used at municipal restaurants, and TDF is accepted at a bike sharing program called Ecobici. When the related literature is considered, studies on the relation between smart cards and the promotion of public transport use are limited; although it might require an in-depth analysis of related data, better examination of this correlation might be beneficial.

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# Modal split, modal shift and the policy environment
## You can't have your cake and eat it too

Justin Hyatt*

**Abstract:** *It is increasingly common for cities to undergo a detailed planning process that spells out the future mobility vision of the city. The Sustainable Urban Mobility Plan (SUMP) is a common tool that is used to this end as a planning guide and strategy document. Many cities are investing in the uptake of sustainable forms of transport, but the extent to which cities have chosen a policy of concerted reduction of automobile use remains unclear. This paper argues that if a city wants to create more spaces for cyclists or pedestrians, it cannot maintain the same level of car trips or the current level of investment in automobile-related infrastructure.*

Sustainable Urban Mobility is an umbrella term that includes specific modes of transport that are sustainable (such as walking or cycling) as well as the policy and management area of urban affairs that connects to sustainable forms of transportation and the creation of a future urban environment that is superior to what we have today.

By default, a future urban environment that is more sustainable will include higher levels of walking, cycling and public transport, as well as lower levels of automobile use. When we look at the current situation in a city, we can quantify the number of trips made by each of the separate modes. This division is the modal split.

By looking at the modal split over time we can see where changes have taken place and note the differences in travel behaviour, with trends pointing to a (usually gradual) shift from one mode to another. This is called modal shift.

Two main questions are considered in this article. Firstly, do cities that have embraced a policy of implementing sustainable mobility measures have a clear plan to reduce the level of car use and car ownership? Secondly, what are the practical implications of a dedicated policy to cut back the level of automobile usage?

### Sustainable mobility is now in vogue
There is currently a high level of interest in sustainable forms of travel. Trends in Europe and North America especially, but also around the world, are very promising.

Many cities are embracing and supporting the uptake of sustainable mobility. Throughout North America, light rail systems are experiencing a renaissance, and public transportation is slowly losing its negative image. Europe is already well advanced in comparison; mobility improvements and new measures are ubiquitous, with funding from the European Union covering many investments as a wide variety of programmes and projects are deployed.

Cycling is also increasing globally. In many cities, travelling by bicycle is considered trendy and bike paths are proliferating, although the bicycle culture and infrastructure of Denmark and the Netherlands continue to lead the world.

However, some questions remain: Do cities that are supporting the transition to sustainable mobility have a clear policy formulation concerning a reduction in automobile usage? Are there dedicated targets aimed at reducing automobile trips? In other words, is a modal shift from driving to cycling, walking and public transport (PT) a component of a city's action plan?

### Planning and the Sustainable Urban Mobility Plan
Let us start by looking at the planning cycle. The preparation of strategic plans for cities is nothing new, but specific planning for sustainable mobility is a fairly recent phenomenon. In some European countries, preparing a sustainable urban mobility plan (SUMP) is mandatory for cities above a certain population, and is generally becoming a standard for inclusion in the plan-

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ning cycle.

SUMPs usually contain an extensive list of objectives, targets, criteria and action areas. These cover a broad spectrum of policies and practices in urban mobility and may include a reduction of airborne particulate matter (PM), reduction of $CO_2$ emissions or other greenhouse gases (GHGs) and a reduction of traffic-related injuries or fatalities. Additionally, they may incorporate performance levels of public transport, speed and efficiency of traffic flow, accessibility of key destinations, and even social values such as reduction in crime and enhancing the attractiveness of a street environment, and economic development.

Many of these key performance indicators benefit from or can be coupled with information and communication technologies (ICT) tools, which are highly beneficial in terms of accessing tangible data for decision making processes.

To be effective, a SUMP must also be accompanied by action plans, with the SUMP itself revised on a regular basis. Monitoring and evaluation tools help ensure that the SUMP's objectives are also being achieved. To this end, the EU project FLOW has developed a methodology to assess the effectiveness of walking and cycling measures, partly by creating tailored transport modelling tools as well as an impact assessment tool. The project also generated a catalogue of congestion reducing cycling and walking measures.

A SUMP – or, otherwise, a city's mobility policy or overall urban development master plan – may also contain specific objectives regarding a desired modal split. As of December 2017, some 542 cities in the EU, Norway, Iceland and Switzerland have been involved in SUMP activities (Rudolph and Damert 2017), so a more in-depth study of SUMP case studies would be required in order to obtain a fuller picture of the variety of objectives currently being pursued in Europe.

### Wide range of objectives
There is clearly a wide range of objectives and policy preferences included, as well as the extent to which a SUMP may set ambitious goals.

The city of Paris has very ambitious goals. Together with its traffic calming and pedestrianisation objectives, the

goals in the city's Mobility Plan of 2007, to be achieved by 2030, include reducing the share of individual car use by 40 percent and achieving a 20 percent increase in public transport capacity.

Budapest has its own mobility goals for 2030: to increase modal share of PT from 45 percent to 50 percent and cycling from 2 percent to 10 percent, and to reduce passenger car transport from 35 percent down to 20 percent.

In the Netherlands, cycling stimulation guidelines that are currently under consideration have outlined a scheme to target commuters and incentivise a switch from driving to cycling that, if successful, would alter the habits of at least 4 percent of the commuting population within two years.

Unwavering dedication to the task is important. The current mayor of Paris, Anne Hidalgo, has demonstrated a near crusader level of zeal for radically transforming the mobility patterns in the City of Light. Budapest's Mayor István Tarlós, however, has recently stated that he does not want to go too far in terms of reining in automobile culture, after a number of pro-cycling and public space improvements were implemented during his tenure.

### Direct and indirect approach to modal shift
Roughly speaking, there are two categories of measures vis-à-vis their direct tackling of automobile use. Naturally, many measures fall on a sliding scale. On the one side, there are measures that a city may take that have the *effect* of reducing car trips, even if that was not the explicit *goal* or an overarching objective. Improvements in PT quality or upgrading rolling stock may have been the actual goal, with reduction in car use as a corollary result.

A good case in point of an approach that is immensely important, yet indirect from the perspective of modal shift, is Vision Zero, as adopted by the city of New York. The defined goal of Vision Zero in New York is to completely eliminate traffic deaths and serious injuries by the year 2024. In order to achieve this, the city has embarked on a series of transformations, with 'complete streets' as the standard for effecting this change, bringing with it a host of pedestrian safety measures, bicycle paths and infrastructure upgrades.

New York's Vision Zero programme did not spell out an objective of reducing private vehicle use, but the sum of the measures implemented does lead to a reduction in driving once walking and cycling has become safer and automobile traffic less dangerous.

At the other end of the spectrum, quantified reductions in automobile use or access may be specifically targeted. Means of achieving these reductions could include the pedestrianisation of certain areas or the introduction of a congestion charge in the central area.

When London and Stockholm implemented congestion charges, taxing vehicles that entered the central zones, this was a direct attempt to reduce city centre driving. The implementation had an immediate effect, both on the number of cars circulating and on the air quality.[1] In the case of London, traffic was reduced by 15 percent, with the level of congestion down by 30 percent. After a decade in use, traffic volumes are down by nearly a quarter.

Pedestrianising a major street or the downtown core of a city will also bring immediate benefits, as will the reduction of space dedicated to automobile travel, such as the number of lanes. Further tools are parking regulation (and limitation) and access provision. The city of Groningen, Netherlands divided its downtown into four quadrants and engineered access between the quadrants in such a way that cars need to drive the long way around, while cyclists and pedestrians have quick, immediate access, thus stimulating the use of active travel modes.

### ICT and innovation
A range of financial measures as well as innovation and technology tools can also be applied to the purpose of encouraging modal shift. These link closely to the overall jurisdiction of mobility management, which handily makes use of the famous carrot-and-stick approach for incentivising and disincentivising.

Mobility as a Service (MAAS) combines technology, mobile applications (apps) and service provision into one, designed to create a seamless transport experience.

Countless other innovations are being developed that connect technology with user experience and may encourage or facilitate sustainable forms of travel.

Apps are at the forefront of technology provided for user services and satisfaction, also in regard to cycling. The Urban Cyclers app, developed in the Czech Republic, provides route information and navigation support, with city specific versions. Officially adopted by the city of Prague, it further offers data concerning user preferences and habits, thus allowing the city to fine-tune problems that are identified over the course of time.

The Interreg funded Movecit project aims to support mobility planning with a focus on employers and institutional mobility plans. Within this project a carpooling app was developed by the Environmental Partnership Foundation (Czech Republic). While still in the early release phase, the app already holds promise to enable large employers to set up effective carpooling schemes, thus reducing the number of single occupant vehicles in commute. This app is set to be available in a number of European countries.

One EU project that focuses on innovation and transport behaviour is EMPOWER, which explores social science experiments and has launched 'living labs', also making use of ICT services, social networks, gamification and data analytics, with the intent to improve mobility services and also encourage positive behavioural change. The EMPOWER Toolkit may hence also be used in developing mobility plans or preparing a mobility strategy infused with ICT and smart services.

### The importance of clearly defining modal shift targets
For cities engaged in SUMP preparation or otherwise defining their strategic goals and future vision, it would be valuable to also develop a clear position towards the level of automobile use they will consider acceptable in the future, as well as an implementation plan with specific, actionable measures. The clearest way to describe mobility targets is by declaring what the desired future modal share targets are and indicating the modal shift action needed to get there.

Several EU-funded schemes concerning transport policy have already been mentioned. However, particularly relevant to the modal shift topic is CREATE (Congestion

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[1]     It should be added that in 2007 New York City proposed a plan to introduce a congestion charge, but the plan was rejected by the state government.

Reduction in Europe, Advancing Transport Efficiency), which is geared towards reducing road congestion and switching from cars to sustainable transport modes.[2] CREATE's self-stated goal is to explore the transport policy evolution cycle and to identify successful factors in encouraging modal shift.

CREATE has identified several stages, or 'perspectives', in the development of cities. Stage 1 is a Car-Oriented City, stage 2 is Sustainable Mobility City and stage 3 is City of Places. While stage 2 already makes way for cycle network enhancements and improving PT, stage 3 has a higher level of traffic restraint and focuses on quality of places. A later stage 4 – an 'integrated city' – was also presented.

These development stages or perspectives represent different future city visions. There is no exact linearity between the stages, and it has been noted that as cities move through stages to greater sustainability, the coexistence of contradictory urban policies remains a major barrier.

This relates to situations where a city government begins investing in sustainable mobility measures or may even declare its city on track towards a carbon-neutral or fully sustainable city, yet still engages in investments that prioritize car use, such as highway infrastructure, road expansion, new roads and bridges or even satellite expansions that are poorly served by public transport.

This type of contradictory urban policy is a common occurence in numerous locations. There are several explanatory factors, including 'old habits die hard' and also the fact that the transition to sustainability frequently must deal with setbacks and pushback.

A deeper explanation relates to the hard measures that are required to orient a city fully towards sustainability. Building a cycle path or improving the public transport network will likely be inoffensive to the vast majority of citizens. However, reallocating road space to other uses, removing parking spaces or introducing a congestion charge will all result in a hefty amount of resistance.

In situations where resistance begins to mount, and a

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2        The project ran 2015-2018. Deliverables and materials available at http://create-mobility.eu/create/home

subgroup raises its angry fist, politicians often pull back from otherwise ambitious or courageous visions. The good news is that in well-documented cases in several European cities (see "Reclaiming City Streets for People: Chaos or Quality of Life"), while a high level of resistance was experienced at first, citizens eventually came around once the project had actually been implemented and the benefits were clearly visible.

Nonetheless, there are plenty of instances that we will never hear about where a project quickly got foiled before ever seeing the light of day.

Thus, we are left with the need for a clear outline and vision that a city can adopt; one that can receive strong support from the highest level of government. However, a clear communication strategy and the inclusion and participation of citizens are equally important.
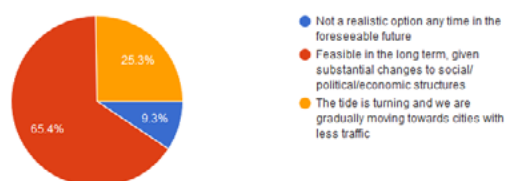
**Prospects of modal shift**
A survey conducted by the author in 2016, targeting the opinions and insights of persons actively involved in urban mobility, corroborated the coexistence of contradictory urban policies, as described above.

In that study, the majority of respondents (68 percent) claimed that their city is working to increase the level of sustainable mobility but without targeting a reduction in car use. Only 20 percent of respondents felt that their city is actually pursuing a reduction in auto use, while respondents at the other end (12 percent) said that nothing was being done to aim for sustainable mobility.
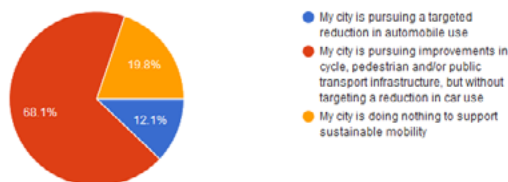
These results go hand in hand with perceptions of what is actually feasible. In another question, respondents indicated that a large-scale modal shift could be possible but would require substantial changes in the prevailing social, political or economic structures.

How do you view the possibilities for large-scale modal shift? Imagine for a moment that your city might go through a process where it radically reduces the volume of automobile traffic.
(182 responses)



- Not a realistic option any time in the foreseeable future
- Feasible in the long term, given substantial changes to social/political/economic structures
- The tide is turning and we are gradually moving towards cities with less traffic

Based on the previous question, what is happening in your city now?
(182 responses)



- My city is pursuing a targeted reduction in automobile use
- My city is pursuing improvements in cycle, pedestrian and/or public transport infrastructure, but without targeting a reduction in car use
- My city is doing nothing to support sustainable mobility

## Competing future visions

It is safe to say that we are now at a crossroads, with competing future visions and possible scenarios up for grabs. Sustainable mobility is getting more attention than ever, as people are better informed about climate change or have simply had enough of gridlock. Furthermore, the logical conclusion of achieving a true shift to sustainable mobility by mandating a significant reduction of automobile use has not yet been satisfactorily embraced as being part and parcel of the solution set.

Part of determining the appropriate solution set for a given city and its population will then also require steadfast decisions, which could mean embracing an approach and set of measures that will be unpopular, at least initially. Simply reaching for the low-hanging fruit will not reap the extent of the changes needed to turn a city into a truly sustainable one.

**BOX – Findings taken from the Furthering Less Congestion by Creating Opportunities For More Walking and Cycling (FLOW) project**

· Pedestrian improvements reduce bus travel times by 40 percent (Strasbourg, France).

· New pedestrian plazas reduce journey times for taxis and buses by 15 percent (New York, USA).

· Narrowing roads to reduce pedestrian crossing distances does not increase congestion (Lisbon, Portugal).

· Cycling improvements led to 45 percent less car traffic and faster public transport (Copenhagen, Denmark).

· Cycle highway reduces time spent in congestion by 3.8 million hours (The Netherlands).

· Cycle highway network reduces the need for 50,000 car journeys daily (Ruhr area, Germany).

· New bike lanes reduce automobile travel times by 35 percent (New York, USA).

· Car-free zone leads to almost 30 percent fewer inner-city cars (Paris, France).

· Neighbourhood access restrictions lead to 16 percent less traffic and 10,000 fewer car journeys a day (London, UK).

· School Streets programme keeps over 4000 cars off streets during peak period (Bolzano, Italy).

· EMPOWER Incentives – rewarding change away from use of conventionally fuelled vehicles, using mobility apps to deliver incentives.

source: http://www.h2020-flow.eu/

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# Electromobility for All
Excerpt from

## Building the Cycling City: The Dutch Blueprint for Urban Vitality

Melissa Bruntlett and Chris Bruntlett*

**Abstract:** *If there's one thing on which manufacturers, retailers, and advocates can agree, it's the potential of the electric-assist bike—or pedelec—to swiftly push cycling into the main-stream. For over a decade now, e-bikes have been leading a quiet revolution on European streets, where a battery-powered motor has added a new level of mobility, diversity, capacity, and range to what was already an amazingly efficient machine.*

Industry insiders will admit their long-term business plans are centered on e-bikes, with their increased profit margins and servicing costs. Those in advocacy circles are excited about their undeniable ability to close both the gender and age gaps, flatten hills, and remove sweat from the equation, thus addressing many of the barriers to the widespread embrace of cycling as a form of transportation.

As development director of the European Cyclists' Federation (ECF) in Brussels, and president of their Cycling Industry Club—a group representing 40 of the world's biggest bike companies—Kevin Mayne has his feet placed firmly in both camps. "I think there's not a shadow of a doubt the e-bike is a tool to bring more people into cycling," he affirms boldly. "There are people that perhaps wouldn't cycle without the feeling they get from extra support. So that broadens the number of participants." The other advantage it offers, Mayne maintains, is making journeys that weren't previously conceivable feel possible. An added boost offers those who believe they can't cycle due to terrain, temperature, or distance an option to arrive at their destination in a timely manner, feeling fresh and composed.

The science backs up Mayne's claims, with a 2015 study from Norway's Center for Gender Research finding e-bikes are ridden twice as far and twice as often as traditional, non-motorized bicycles, with the biggest impact on women and seniors. This offers some potentially dramatic changes to transportation patterns within cities, with very real impacts on car ownership and congestion rates.

A 2017 study from the German Federal Environmental Agency discovered that, in an urban setting, regular bikes are faster than cars for trips up to five kilometers. With pedelecs, this radius is increased to ten kilometers, with a marginal difference for distances up to twenty kilometers. "We're no longer talking about the bicycle as a solution for five-kilometer trips," states Mayne. "We're talking about the bicycle as a solution for *most* trips."

There are still some purist voices that denounce e-bikes as "lazy" and "cheating," but Mayne argues that they must be ignored. "If we take the voices of the sporty fit to write the books, we end up with helmets and Lycra, and we end up with no e-bikes. So we have to switch off those voices," he insists. "It's not for you. It's for someone else."

Despite its mostly flat terrain, the Netherlands has emerged as the world's largest pedelec market per capita, with electric bikes making up almost a third of new bicycle sales in 2016. Denmark is a close second, proving to experts like Mayne that infrastructure is absolutely critical, and e-bikes won't sell in significant numbers without a safe space on which to ride them: "The numbers show

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that countries with good and developing infrastructure have good and developing e-bike markets."

Another crucial ingredient to burgeoning e-bike use is the availability of a safe space in which to store them. "Parking is a huge issue," explains Mayne. "It's a €3,000 unit, instead of a €150 to €200 unit. People don't want to leave machines of that cost on the street. They want lockers, underground garages, and secure parking at stations." This is one area where the Dutch excel, installing large-scale bike-parking structures within their cities. Known as *fietsenstallingen*, these ample, secure, end-of-trip facilities can be found at major living, working, and shopping destinations, complete with entrance escalators, maintenance facilities, and on-site security staff.

The fact that over 80 percent of e-bike sales in the Netherlands are made to people over the age of 50 demonstrates their unparalleled ability to preserve personal mobility and encourage healthy, active transportation habits well into old age. "There is a need in society to get older, heavier, less fit, and different gender groups active," acknowledges Mayne. He believes the e-bicycle and e-tricycle offer real opportunities in that area, and governments facing ballooning healthcare costs should be thinking about them as game changers: "We're familiar with personalized mobility scooters for the really elderly on the high street. This is a bridge. And it's a lot cheaper."

To see that return on investment, Mayne and the ECF are lobbying governments all over Europe to reconsider their fiscal policies related to electromobility. "If, for reasons of inclusion, you want to make the e-bike part of your solution, they are expensive. So cost is clearly is a barrier. Including them in any taxation benefits, or electric-mobility subsidies, is essential," he suggests. While many bureaucrats seem to be betting on a transportation future centered on the electric car, they're ignoring the fact that e-bikes could provide them with a much bigger return on investment.

Germany provides the most striking example of this, where €1.4 billion in electric-car subsidies resulted in just 24,000 units sold as of 2014. Meanwhile, with zero government subsidies, an incredible 2.1 million e-bikes now motor along German streets.

Belgium, on the other hand, is experimenting with a different incentive model, which, for the past six years, has rewarded bike commuters with a €0.22 bonus for each kilometer ridden. The average Belgian who cycles to work rode 1,045 kilometers in 2016, making them eligible for a €230 refund. The e-bike suddenly makes those numbers more enticing. "If you ride a pedelec for a 20-kilometer round trip, you're going to accumulate a lot of kilometers," asserts Mayne, pointing out that such a distance would entitle someone to a €924 annual rebate. "That goes a long way to supporting your bike. So the per-kilometer model incentivizes e-bikes quite well."

Mayne's major challenge over the coming years will be to convince these industry players to get behind the ECF's push for safer streets and better bicycle infrastructure in urban centers across the continent: "I'm communicating back to the industry: "This looks like a magic bullet at the moment, but you need to support us on getting infrastructure built and making roads safer, because the market will plateau." In order to fulfill those optimistic business plans, and realize the projected profits, these business owners must help ensure that their customers have great places to ride.

And so, tempering the expectations of manufacturers, retailers, and advocates is perhaps Mayne's most important role, as well as emphasizing the fact that those new users and new trips won't appear without significant investments in active transportation. Getting the basics right has to come first when it comes to increasingly cycling rates and sales of new bicycles—whether electric-assist or not. As Mayne points out: "The underlying belief that e-bikes will fix everything is a bit like expecting e-cars to fix everything. It's just another form of the same mobility. So the underlying issues of infrastructure, parking, and safety are not resolved by the technology."

On that front, their daunting and difficult work is just getting started.

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*If you enjoyed this adapted excerpt from "Building the Cycling City: The Dutch Blueprint for Urban Vitality", the full volume is NOW AVAILABLE from [Island Press](#) as a hard copy or e-book (use promo code "4DUTCH" for 20% off the print version), as well as [Amazon](#), [Indigo](#), and anywhere else fine books are sold.*

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# Building the Cycling City: The Dutch Blueprint for Urban Vitality

*Around the world, countries marvel at the Netherland's impressive cycling culture and infrastructure while an insidious "that would never work here" attitude prevents real change from happening. But the Dutch overcame many of the same challenges as other car-clogged countries, and their story is an important model for moving the rest of the world toward a more human-scale, bike-friendly future.*

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