Athens, Greece
Smarter Cities Challenge report

IBM

Contents

1. Executive summary

Introduction

The City of Athens, Greece, is one of 16 cities selected to receive a Smarter Cities Challenge® grant from IBM in 2015 as part of the company's citizenship efforts to build a Smarter Planet®. During three weeks in November 2015, a team of six IBM experts from five countries worked with Mayor Yiorgos Kaminis, Deputy Mayor Antonis Kafetzopoulos, Municipality General Secretary Eleftherios Kastanakis, City Councillor Elias Vlachakis, DAEM. Executive Consultant Giannis Ramfos and other key stakeholders to deliver recommendations on a key challenge:

Improve the quality of life in the historical and commercial city centre by reducing traffic congestion and reclaiming public spaces.

The challenge

The municipality of Athens is the most populous in Greece, with a population of 664,046 (2011) and an area of 39 kilometres (15 square miles). During the last century, Athens saw its population increase rapidly. Approximately 45% of the Greek population, about four million people, live in greater Athens. This has led to increased pressure on urban infrastructure and transportation. Athens is a highly car-dependent city, and the long-term goal of the Municipality is to encourage citizens to alter their daily travel habits in order to support a more sustainable mobility strategy.

Against this backdrop, it remains a city blessed in historical riches, with the beautiful Acropolis crowned with the Parthenon looming above it, and tourism has been steadily increasing in the last three years.[1] The mayor's vision is to improve the quality of life in the commercial and historical centre of the city — the triangle between the squares of Syntagma, Monastiraki and Omonia (see Figure 1) — through reclaiming the public space, banishing illegal parking of cars and motorcycles and making it a place in which people want to live, work and visit. Starting in a small area in the centre, regeneration should spread out over time to other parts of the city, generating economic growth and restoring Greek pride in one of the most historical and fascinating capital cities in the world.

With these challenges in mind, the City outlined the following primary objectives:
- Reduce traffic congestion by using smart technologies for efficient transportation and parking management
- Improve accessibility, especially for people with disabilities
- Increase public transportation usage
- Leverage real-time and predictive analytics
- Increase compliance with existing regulations
- Minimise the environmental impact of traffic congestion
- Improve the quality of life for residents and visitors
- Strengthen public engagement and support
- Apply best practices from other cities

Figure 1: The historical city centre, including the commercial triangle

Findings and recommendations

This report provides recommendations for the execution of this vision so that it becomes a reality. It provides a long-term strategic view and, while recognising the many constraints within which the Municipality operates, pragmatic steps that can be initiated immediately.

After reviewing and analysing information from extensive research and 33 interviews with more than 100 stakeholders, the IBM Smarter Cities Challenge team developed the following recommendations in six categories (see Figure 2).

Conclusion

Athens has many advantages in terms of its natural beauty and historic significance. The IBM team met with many inspirational people who were passionate about the city and dedicated to improving the quality of life within it. However, there are significant challenges that must be addressed to ensure sustainable economic growth, local productivity, improved public safety and continued quality of life.

Implementation will deliver a broad range of benefits for the city's efficiency and attractiveness. Benefits include a decrease in traffic congestion, easy-to-use transportation services, engaged citizens, Athens becoming a top tourist destination, the reduction of carbon emissions, a financially viable transportation ecosystem, a thriving business economy and growth in tourism and tourist satisfaction.

Athens will be moving in the same direction as many other European cities as it follows this path towards becoming a Smarter City.[2] The European Union is driving a number of initiatives here by monitoring and learning from the activities of several pilots in Lyon, Madrid, Torino, Birmingham, Gothenburg and Wroclaw. Engaging in information sharing and collaboration with these initiatives should prove advantageous and position Athens as a city that has both a vision and a strategy to achieve it.

Strengthen regulation enforcement in the city centre, both by using technology to supplement enforcement and by making it easier for people to comply with regulations.

Develop a comprehensive multimodal transportation strategy to reduce reliance on cars and encourage the use of alternative ways to travel, including bikes.

Deploy intelligent transportation technology to effectively control the flow of traffic, provide a single view of all transportation and effectively react to major incidents.
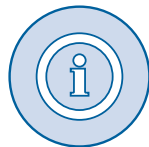
Cultivate public and private information sharing to make Athens a data-driven city, applying analytics for insight into all aspects of city life and enabling entrepreneurial people to create value from the data.
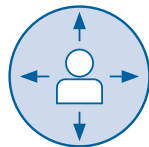
Engage Athenians on the transportation vision through multimedia, using social media to make people feel pride in the city and support the initiatives to improve it.
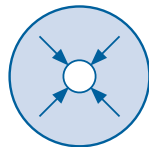
Set the foundation for a Metropolitan Transportation Authority to coordinate the various activities across the spectrum of transportation options, including tram, bus, trolley, metro and roads.

Figure 2: Recommendations

2. Introduction

A. The IBM Smarter Cities Challenge

By 2050, cities will be home to more than two-thirds of the world's population. They already wield more economic power and have access to more advanced technological capabilities than ever before. Simultaneously, cities are struggling with a wide range of challenges and threats to sustainability in their core support and governance systems, including transportation, water, energy, communications, healthcare and social services.

Meanwhile, trillions of digital devices, connected through the Internet, are producing a vast ocean of data. All of this information — from the flow of markets to the pulse of societies — can be turned into knowledge because we now have the computational power and advanced analytics to make sense of it. With this knowledge, cities could reduce costs, cut waste and improve efficiency, productivity and quality of life for their citizens. In the face of the mammoth challenges of economic crisis and increased demand for services, ample opportunities still exist for the development of innovative solutions.

In November 2008, IBM initiated a discussion on how the planet is becoming "smarter". By this it meant that intelligence is becoming infused into the systems and processes that make the world work — into things no one would recognise as computers: cars, appliances, roadways, power grids, clothes and even natural systems, such as agriculture and waterways. By creating more instrumented, interconnected and intelligent systems, citizens and policymakers can harvest new trends and insights from data, providing the basis for more-informed decisions.

A Smarter City uses technology to transform its core systems and optimise finite resources. Because cities grapple on a daily basis with the interaction of water, transportation, energy, public safety and many other systems, IBM is committed to a vision of Smarter Cities® as a vital component of building a Smarter Planet. At the highest levels of maturity, a Smarter City is a knowledge-based system that provides real-time insights to stakeholders and enables decision makers to manage the city's subsystems proactively. Effective information management is at the heart of this capability, and integration and analytics are the key enablers.

Intelligence is being infused into the way the world works.

The IBM Smarter Cities Challenge contributes the skills and expertise of top IBM talent to address the critical challenges facing cities around the world. We do this by putting teams on the ground for three weeks to work closely with city leaders and deliver recommendations on how to make the city smarter and more effective. More than 130 cities have been selected to receive grants since 2010. The Smarter Cities Challenge is the company's largest philanthropic initiative, with contributions valued at more than $66 million to date.

The City of Athens, Greece, was selected through a competitive process as one of 16 cities to be awarded a Smarter Cities Challenge grant in 2015.

During a three-week period in November of 2015, a team of six IBM experts worked in Athens to deliver recommendations around key issues for infrastructure and transportation.
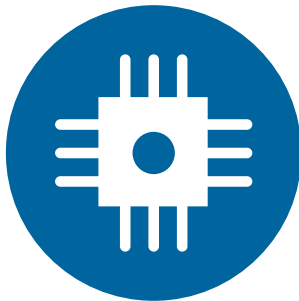
Instrumented
We can measure, sense and see the condition of practically everything.
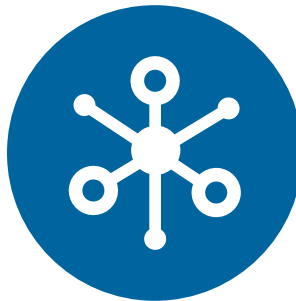
Interconnected
People, systems and objects can communicate and interact with one another in entirely new ways.

Intelligent
We can analyse and derive insight from large and diverse sources of information to predict and respond better to change.

Figure 3: Instrumented, interconnected, intelligent

B. The challenge

During the last century, Athens saw its population increase rapidly. Approximately 45% of the Greek population, or about four million people, live in greater Athens. This has led to increased pressure on urban infrastructure and transportation. Athens is a highly car-dependent city. The long-term goal of the Municipality is to encourage citizens to alter their daily travel habits to support a more sustainable mobility strategy.

The mayor's vision is to improve the quality of life in the commercial and historical centre of the city — the triangle between the squares of Syntagma, Monastiraki and Omonia (see Figure 1) — through reclaiming the public space, banishing illegal parking of cars and motorcycles and making it a place in which people want to live, work and visit. Starting in a small area in the centre, regeneration should spread out over time to other parts of the city, generating economic growth and restoring Greek pride in one of the most historical and fascinating capital cities in the world.

With these challenges in mind, the City outlined the following primary objectives:
• Reduce traffic congestion by using smart technologies for efficient transportation and parking management
• Improve accessibility, especially for people with disabilities
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• Leverage real-time and predictive analytics
• Increase compliance with existing regulations
• Minimise the environmental impact of traffic congestion
• Improve the quality of life for residents and visitors
• Strengthen public engagement and support
• Apply best practices from other cities

3. Findings, context, approach and roadmap

A. Findings, context and approach

Findings

The opening of the Metro prior to the 2004 Olympics, along with the transformation of select streets in the city centre to pedestrian walkways, has improved mobility; nonetheless, Athens remains highly dependent on cars compared to other European capitals, with congestion expected to worsen once travel returns to previous levels as the economy recovers.

Overall, Athens faces the following key challenges to improving accessibility and mobility in the historical and commercial centre:

- Illegal parking and other public space violations are common in the central district.
- Enforcement of parking and other fines could be improved through process redesign and better use of technology, creating a disincentive for driving in the historical and commercial centre of the city.
- Tourist buses and taxicabs compete for limited space, and parking rules are either confusing or ignored. Similarly, there is a lack of rules and limited infrastructure for motorcycle parking in the pedestrian streets.
- Roads, pavement and some transit infrastructure are in disrepair; for example, signage and bus stops require maintenance or replacement, and there is limited access for bicycles and for people with disabilities.
- Reliance on cars could be further reduced through new policies and long-term investments; for example, the City of Athens could increase pedestrian access, redirect parking outside the central district, improve transit coverage and service quality, reduce the number of taxis and encourage bicycling.
- The Athens Traffic Management Centre currently is not operational and is severely understaffed, and the different systems that manage the region's various road and transit networks are not integrated.

- Data on transportation and mobility is not widely shared between government departments and with external organisations.
- There is no single point of accountability for transportation strategy and operational management in the greater Athens region (known as Attica) because the responsibilities for different types of roads and transportation infrastructure are divided across municipal, regional and national governments.

Context

As the capital of the country — located in an attractive coastal area — and home to numerous sites of immense historical interest, Athens has the potential to become an economic engine for Greece and a major global tourist destination.

At the centre of Athens is the historical and commercial district, with major squares forming the "commercial triangle", surrounded by the Acropolis, the ancient neighbourhood of Plaka, major parks and museums, as well as numerous government and business buildings.

Mobility is a key part of the mayor's strategy to revitalise the economy and improve the quality of life for residents. This requires reducing the reliance on cars for travel, improving access to the centre and reclaiming public space for pedestrians and bicyclists.

Numerous other cities in Europe, most with historical centres of national and global interest, have embarked on similar mobility strategies as part of larger revitalisation programmes. The centre of Venice is completely car free, and the central districts of Amsterdam, Berlin, Brussels, Copenhagen, Helsinki, Stockholm, Vienna and others have major car-free zones that are heavily reliant on public transportation and bicycles for access.

Approach

The Smarter Cities Challenge team took an immersive approach to understanding the City's challenges, conducting 33 structured interviews and workshops with more than 100 stakeholders, collecting and analysing more than 100 documents, exploring existing pilots and early adoptions of various recommendations, personally using public transportation and walking the city centre to discuss pilots and plans with City officials and multiple service providers.

After synthesising the information, the IBM team developed a set of core recommendations grouped into the following six key areas:

These recommendations encourage a shift to an integrated and centrally controlled transportation strategy and ecosystem. That strategic vision must be balanced with short-term actions to address specific issues and derive value quickly.

The IBM team held several checkpoint meetings with Municipality officials to ensure it was working towards the right balance between tactically implementable actions and bold, forward-thinking recommendations.

1   **Strengthen regulation enforcement in the city centre**
     1.1   Use technology to strengthen enforcement
     1.2   Make it easier for people to adhere to regulations

2   **Develop a comprehensive multimodal transportation strategy**
     2.1   Define and ensure compliance with rules on parking for tourist buses
     2.2   Improve pedestrian streets and prioritise additional streets for conversion
     2.3   Establish a long-term strategy to reduce the use of cars

3   **Deploy intelligent transportation technology**
     3.1   Deploy an Operations Centre to aggregate data and to monitor and coordinate mobility for Attica
     3.2   Redeploy and upgrade the Regional Traffic Management System
     3.3   Deploy video analytics system

4   **Cultivate public and private information sharing**
     4.1   Engage public and private businesses and citizens in cooperation through Open Data
     4.2   Engage with inter-agency stakeholders to enable real-time information hub

5   **Engage Athenians on the transportation vision through multimedia**
     5   Launch a campaign to engage the public to help reduce congestion and reclaim public spaces

6   **Set the foundation for a Metropolitan Transportation Authority**
     6   Align governance with goals

Figure 4: Recommendation summary

B. Roadmap

The Smarter Cities Challenge team mapped each of the 29 projects onto a roadmap spanning from 2016 through 2020 (see Figure 5). This requires buy-in from a diverse group of stakeholders, a comprehensive plan for implementation and strong political will. The roadmap includes projects to execute in the short term as foundational steps for future, more-advanced projects.

	2016	2017	2018	2019	2020
Enforcement	Offer violation reporting using app and social media Extend electronic ticket issue and analytics Re-engineer the fines collection process Create motorcycle parking spaces	CCTV for public space encroachment Enable mobile parking payments	ANPR for specific parking enforcement		
Multimodal	Develop long-term multimodal strategy Create bike sharing/bike lanes Implement motorcycle permits Engagement to agree tourist bus policy Conduct siting study for taxi's parking lots Utilisation of roofed and open-air parking lots	Promote ride sharing programme Create park and ride lots Improve pedestrian streets and agree next streets Add electric car charging stations		Launch dynamic congestion pricing for cars	
Intelligent transportation	Integrate road and transit systems Restart Regional Traffic Management System	Deploy electronic fare system for all transport modes Apply video analytics			
Information and data	Appoint Municipal Chief Data Officer Establish Open Data Initiative	Create Municipal Information Hub			
Communication	Deploy "mood kiosks" Launch a campaign Establish social sites to engage and listen				
Organisation	Appoint Municipal Project Leader	Cross-government mobility forum	Metropolitan Transportation Authority		

Figure 5: Proposed programme roadmap

Several of the recommended projects are under the direct control of the Municipality of Athens, whereas others require active partnership and coordination with regional and national agencies, which adds complexity to their execution. At the mayor's request, the IBM team selected a subset of projects that should begin immediately (see Figure 6). These are projects with strong benefits that the City can implement with limited cross-governmental coordination or are crucial enough that the mayor should play a catalysing role in promoting action.

3 months	6 months	9 months	12 months	Year 2	Year 3

Re-engineer the fines collection process

Extend electronic fine issue and analytics

Review delivery and waste-collection times

Create motorcycle parking spaces and permits

Add bike racks — Add bike lanes

Improve public space access on existing pedestrian streets

Engagement with Tourist Bus Policy Agreement — Yes/No decision

Develop long-term multimodal strategy

Redeploy and upgrade traffic management system

Launch parking space finder app

Create Municipal Information Hub

Launch a campaign

Appoint Municipal Project Leader

■ Enforcement   ■ Multimodal   ■ Intelligent transportation   ■ Information and data   ■ Communication   ■ Organisation
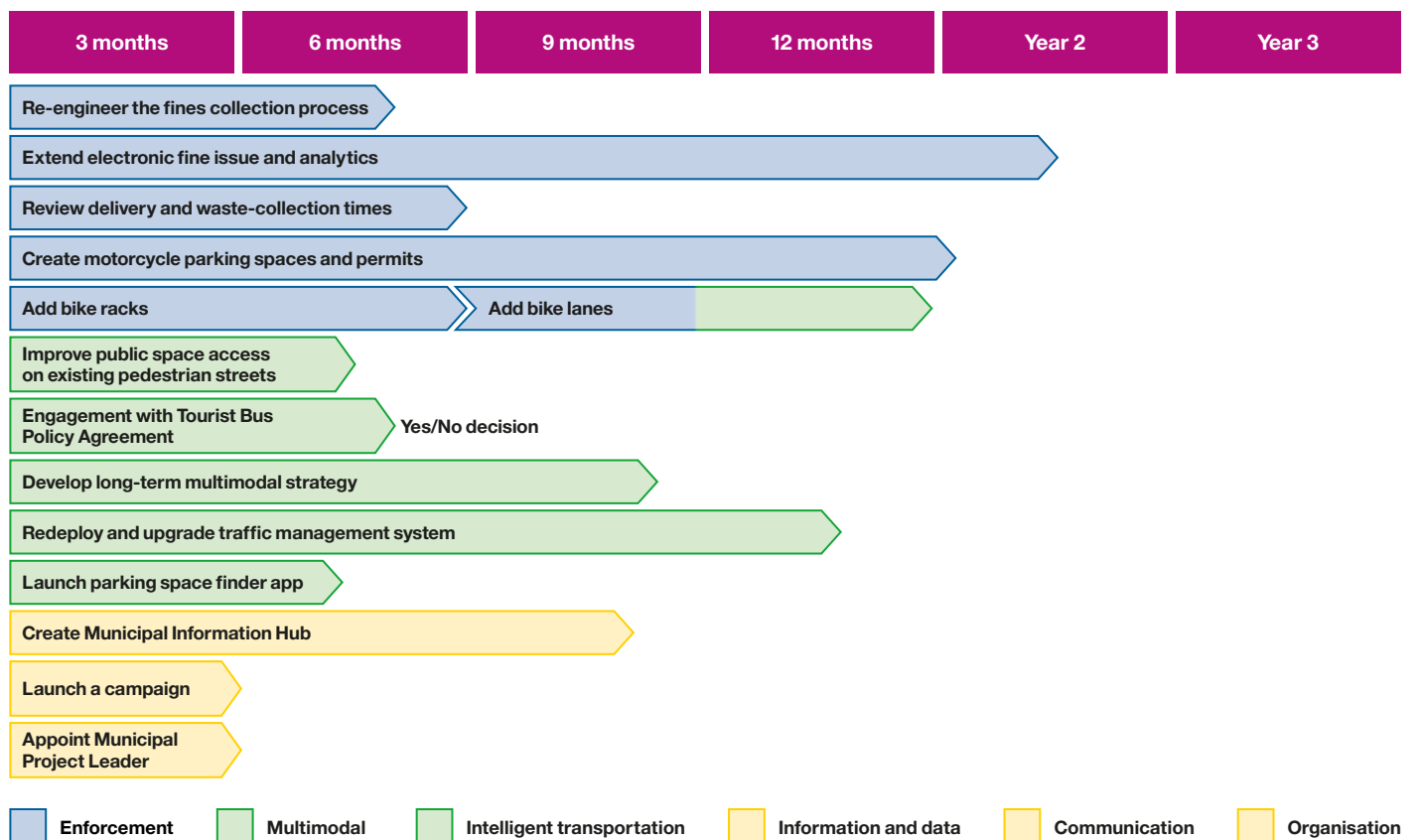
Figure 6: Proposed project durations

4. Recommendations

1. Strengthen regulation enforcement in the city centre

The public spaces — squares, pedestrian streets — in the commercial and historical centre of Athens are obstructed by a number of illegal encroachments that make the area difficult for pedestrians to walk through. It is especially difficult for people with disabilities. The main problem is when people park their cars and motorcycles illegally and when cafes and restaurants place tables and seats in public spaces for which they are not licensed. Generally, the legal and regulatory framework that covers parking in the commercial and historical centre is considered adequate and fit for purpose. However, the regulations are not easily enforced, and therefore there are few deterrents to breaking them.

Nearly all of the stakeholders the IBM team consulted during the course of this study said that nothing would change unless the enforcement of parking and public space encroachment was made robust, accurate and effective. The stakeholders proposed a number of reasons why that is not the case today, including insufficient Municipal Police, a lack of political will to pursue offenders, lengthy and inefficient parking fine issuance and collection, the presence of multiple organisations in the end-to-end process. The IBM team's recommendations cover the improvement and effectiveness of enforcement as a deterrent, as well as how to make it easier for people to adhere to the regulations.

1.1 Use technology to strengthen enforcement

The Municipal Police are under resourced. There are relatively few officers monitoring parking spaces and issuing parking tickets and other fines; there are now about 100 police as opposed to 1,100 several years ago. Because it is not commercially viable to significantly expand the Municipal Police force, a strategy to apply technology to supplement their efforts is recommended. This could be applied effectively in the following areas:

a. Re-engineer the process of issuing and collecting fines

Both Municipal Police and Traffic Police can issue parking tickets. Traffic Police do not focus on the smaller streets, which are the responsibility of the Municipality, and illegal parking is not a priority for them unless it blocks roads, as they are more concerned with accidents and dangerous activity, such as drunk driving, talking on mobile phones while driving and so on.

The parking fine system is complex and involves gathering information from both the Ministry of Transportation and the Ministry of Finance in order to identify the owner of the vehicle and their VAT tax number. The fines process for several other violations, such as waste management, also requires contacting the Ministry of Finance for the VAT number. There are lengthy delays at each of these steps. It is recommended that the Municipality work with the Ministries of Transportation and Finance to assess how the process can be expedited through a programme of automation: for example, using application programming interfaces (APIs) or other web services to send, match and receive the owner data and the VAT data. Because there are several agencies involved in the process, this would have to be governed as a cross-departmental initiative.

b. Automate parking enforcement for areas where illegal parking causes the most disruption

For areas where illegal parking causes the most disruption, such as parking in bus lanes and taxi ranks[3], the entire process from detecting a parking offence to issuing a ticket could be automated. This could be effected by the use of closed-circuit television (CCTV) cameras with Automatic Number Plate Recognition (ANPR) technology. Either fixed camera placement or CCTV-equipped cars parked in strategic areas could be used, and this would have the added advantage of providing real-time information in the case of emergency situations.

It should be noted that trials in other cities, such as London (Westminster), have surfaced strong resistance to automatic parking ticket issuance for general public spaces.[4] However, it is acceptable in many cases for specific use, such as keeping bus lanes clear.

Another potential use of ANPR is to identify vehicles entering the city centre at specific junctions. If any are identified as having outstanding parking fines, they can be flagged to the police who can take appropriate action. This could be, for example, an on-the-spot fine or a formal warning.

In the short term, and as a first step without additional technology, the Municipal Police should focus on enforcing the regulations on illegal parking in bus lanes and taxi ranks, as this has been raised by several stakeholders as a significant issue because it contributes to congestion and restricts the movement of the tourist buses that bring revenue to the commercial centre.

c. Extend PDA and tablet parking ticket issuance to monitor and measure performance

The Municipality already uses PDA devices to issue tickets, and this should be extended to all police officers operating in the area, whether Municipal Police or Traffic Police. This will have a number of benefits. Only 6% to 8% of tickets issued electronically are cancelled, while there is a high rate of cancellation of fines associated with paper tickets. Use of PDAs or tablet devices across the city centre will provide a more robust and effective system for tracking fines and minimising cancellations.

The Municipality should also maximise the insight that can be gained from the digital data generated by electronic ticketing. For example, trending data as to where most tickets are issued could lead to an increased focus by the Municipal Police on violation hot spots to reinforce efforts to regain compliance. In order to encourage the Municipal Police to issue tickets for parking offences, the Municipality should consider giving them targets to meet. This could be, for example, a minimum number of tickets to be issued each day. This is standard practise in many cities to ensure enforcement works at a practical level.

A further suggestion is to supplement the Municipal Police with a licensed private security company. This model is widely used in other cities and is funded by the company that keeps a portion of the revenue. It is also a model similar to that of DAEM, the Municipality's IT organisation, that has been formed as a public limited company.

d. Multipurpose use of intelligent CCTV for other infringements

A network of Intelligent CCTV cameras, with video analytics, also could be used to identify other violations in public spaces. Modern analytics technology allows for rapid search and identification and removes the need for people to view long sections of footage. These other uses of CCTV could include capturing infringements, such as exceeding the number of tables and chairs allowed outside restaurants and cafes, store deliveries that are outside of the specified loading hours and use of vehicles that exceed the size and weight limits and are therefore likely to damage pavements and street furniture.

There may be opposition to the use of cameras due to potential abuse of personal privacy, and the Smarter Cities Challenge team understands that this is an issue that has already arisen in Greece. Consultation with the Hellenic Data Protection Authority will be required to come to an agreement. It has been suggested that designating the small pedestrian area as private rather than public — for data privacy purposes only — may be appropriate and will allow wider freedom to use the CCTV technology, but this will need verification.

More information on the multipurpose use of CCTV technology can be found in Recommendation 3 for intelligent transportation.

e. Extend violation reporting by using the existing CRM system, via apps or through social media

Although some stakeholders suggested that citizens of Athens do not have a culture of reporting infractions to the authorities, others believe that this is changing. There is a current multi-channel mechanism for citizens to report issues through a portal, email (TEP@CityofAthens.gr) or a 4-digit telephone number (1595) to the Municipality. Citizen reports get logged in the CRM system and are automatically routed to the relevant department.[5] Currently, the Municipality receives about 300 reports a day, roughly divided as 200 calls, 80 – 90 emails and 10 – 20 portal entries.

The major causes for complaint are problems with cleanliness, such as rubbish and dirt in the streets, poor street lighting, potholes and other issues with road surfaces, public space encroachment, especially by cafes and restaurants taking over space with tables and chairs and environmental issues, such as stray animals and recycling.

The Municipality is starting an initiative with a not-for-profit organisation to build a City'R'Us app for mobile phones that will provide another channel for reporting violations. Increased use of these types of apps for reporting infringements in public spaces should be encouraged, and violation reporting using social media, such as Facebook and Twitter, which are widely used by the Athenians, should also be enabled. This could be done through the Information Hub described in Recommendation 4.

Recommendation 1.1: Use technology to strengthen enforcement

The City of Athens should use technology to strengthen law enforcement.

Scope and expected outcomes

Scope
- Re-engineer the fines process and automate where possible by using the web or APIs to retrieve vehicle owner and VAT data, for example
- Automate the end-to-end parking enforcement process via CCTV and ANPR for illegal parking, such as in bus lanes and taxi ranks
- Extend electronic ticketing for parking violations and analyse the digital data, such as trending data for violation hot spots
- Multipurpose use of CCTV and video analytics to better understand issues, like cafe public space encroachment, store deliveries outside loading hours, vehicles exceeding size and weight limits
- Extend violation reporting via apps and through social media, as well as possibly through the Information Hub

Expected outcomes
- The quality of life in the centre of Athens will be improved.
- Expanding the Municipal Police is not viable in the current economic climate, and technology is a cost-effective way to supplement or automate enforcement.
- The data generated can be enriched via analytics to provide valuable insight.
- Revenues from parking fines will increase.

Cost of inaction
Without enforcement, there is no effective deterrent, and offending will continue at the current levels, resulting in obstruction and encroachment of public spaces.

Proposed owner and stakeholders	Suggested resources needed
Owners: Municipality, DAEM **Stakeholders:** - Ministry of Infrastructure, Transport and Networks - Ministry of Environment, Energy and Climate Change - Ministry of Finance - Traffic Police - Municipal Police	Programme management, technology consulting, legal input regarding use of personal data/images, installation and configuration resources **Cost estimate:** Medium — These technologies are becoming increasingly commoditised and affordable. However, because devices need to be installed on street furniture, such as lampposts, the project will generate manpower costs as well as technology costs.

Recommendation 1.1: Use technology to strengthen enforcement (continued)	
Dependencies	**Key milestones, activities and time frame**
• Approval by data protection authorities regarding sharing of personal data and image capture. • Buy-in from all stakeholder communities. • Physical installation is not obstructed and is vandal-proof.	**Short to medium term** • Initiate a cross-departmental programme to define and implement a more automated end-to-end parking enforcement process (can be extended to other fines/violations) • Extend PDA and tablet ticketing to all police operating in the triangle (use analytics for measurements and targeting • Assess viability of installing multipurpose CCTV with video analytics and ANPR — including consultation with the Hellenic Data Protection Authority

Priority
High — To stop illegal parking, deliveries, overweight vehicles and space encroachment, deterrents need to be put in place as soon as possible or the city centre will remain difficult to navigate for pedestrians, and the Municipality's ambition to create a central area attractive to residents, businesses and visitors will not be realised.

1.2 Make it easier for people to adhere to regulations

There are some obstacles that make it difficult for well-meaning people to adhere to the regulations, and these need to be removed. Examples of such obstacles include parking and other signage that is not always clear and visible, the high price of parking in the central area (see Figure 7), parking places and payment points are not always easy to find and the delivery time regulations do not reflect the store hours. One of the biggest challenges is the large number of motorcycles that are illegally parked. However, there are no officially designated parking spaces for motorcycles. To improve the situation, the Smarter Cities Challenge team suggests focusing on the following two areas:

1. Help people find empty parking spaces easier, both outside as well as inside the triangle, and make it easy to pay. Include motorcycles as well as cars in these programmes.
2. Review the Smart Parking pilot for lessons learned and define a programme with extended scope.

Figure 7: Parking tariff in Kotzia Square (note that it costs 10 euros to park for up to one hour, while it costs 48 euros to park for 20 hours)

Compliance incentives could also be considered, such as reduced municipal tax for compliant businesses (or, conversely, increased municipal tax for persistently offending businesses). One way to encourage drivers to park in designated parking spaces, rather than in the public spaces meant for other uses, is to make it easy for them to find legal parking spaces. The Municipality, through its IT arm, DAEM, has conducted a pilot using 160 wireless sensors, on several streets, that identify whether a parking space is available or in use. This information is made available through several ways: electronic displays showing the number of available spaces in areas covered by the pilot and an app that colour codes the spaces to indicate whether they are likely to be available. The great advantage of this kind of system is that it eases congestion by preventing vehicles from circling the city in search of a parking space, and it is estimated that 30% of traffic in a city is caused by people driving around looking for parking.[6,7] The system also can reduce illegal parking where drivers simply give up and park wherever they can.

There are many benefits to using sensor technology to control parking, but there are also limitations. The sensors currently deployed only show an on/off status, in other words, whether or not the space is occupied. It could be possible to time how long the car has been parked there by capturing the times the switch status changed, which could indicate whether a vehicle has exceeded its allotted time in the space. However, there is no way at present to indicate whether the driver has paid to use the space, as the space and the payment cannot be connected.

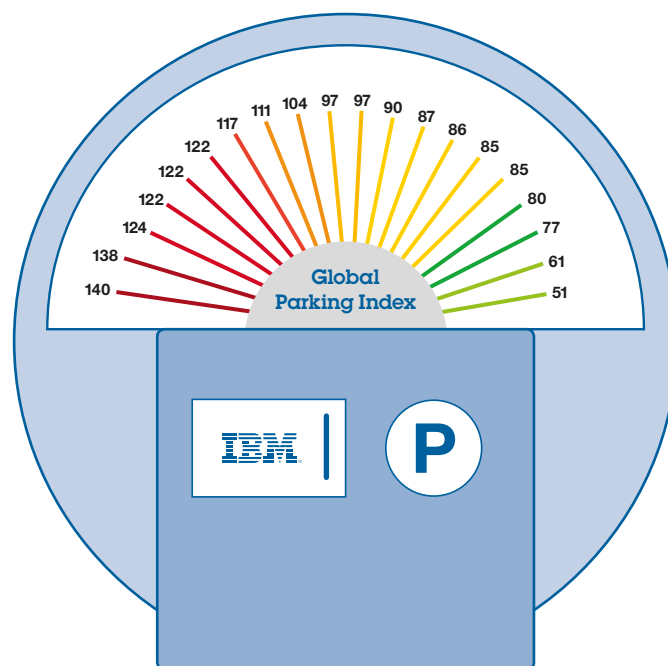|				
140	New Delhi		97	Mexico City
138	Bangalore		90	Stockholm
124	Beijing		87	Johannesburg
122	Moscow		86	London
122	Shenzhen		85	New York City
122	Paris		85	Montreal
117	Milan		80	Buenos Aires
111	Nairobi		77	Toronto
104	Madrid		61	Los Angeles
97	Singapore		51	Chicago

Figure 8: IBM Global Parking Index

a.   Introduce a mobile phone payment system for parking

One way to resolve this could be to introduce an electronic payment system, such as a mobile phone payment system commonly in use in many countries. The Athens Urban Transport Organisation S.A. (OASA) is introducing a mobile payment system for bus and Metro tickets, so citizens and visitors to Athens will be accustomed to this approach. It may be worth investigating whether this system, or components of it, such as the payment engine, could be extended to cover parking payments.

There are a number of ways that the space can be connected to the payment, and many new approaches, using cameras for example, do not require a unique reference number physically marked on the space. This is a benefit because maintaining the marking — whether special paint or a metal plate affixed to the space — needs careful consideration.

A number of stakeholders have observed that once they have found a legal parking space, it is not always clear where the pay booths are, and they may be quite a long walk from their vehicle. Technologies to make it easier to pay, such as the mobile phone payment system suggested above, which are now widely in use in many countries, can resolve this. These systems have the added advantage of providing data that can be exploited through analytics to give the Municipality insight into parking patterns and the ability to connect the space to payment data.

The DAEM pilot should be reviewed, and the lessons learned should be applied to a programme with a more comprehensive scope, in terms of coverage (extended to the entire commercial and historical district, including private parking lots), functionality (connecting the space to the payment information) and a review of the technology deployed. The latter is important because if the Municipality plans to introduce CCTV technology for a broader use, this has the potential to replace the sensor system and may prove a more cost-effective option.

b.   Create parking spaces for motorcycles

Finally, it is clear just from walking the city streets that illegal motorcycle parking is a serious issue. The Municipality must work with the private parking companies to create spaces for motorcycle parking. And the Municipality should provide resident motorcycle permits.

Recommendation 1.2: Make it easier for people to adhere to regulations

The City of Athens should make it easier for people to adhere to the regulations.

Scope and expected outcomes

Scope
- Help people find empty parking spaces, both outside and inside the triangle, and make it easier to pay. Include motorcycles as well as cars in these programmes.
- Implement Smart Parking. The DAEM pilot should be reviewed and applied to a programme with a more comprehensive scope: in terms of coverage (extended to the entire commercial and historical district, including private parking lots), functionality (connecting the space to the payment information) and a review of the technology deployed (sensors and CCTV with video analytics).
- Introduce a mobile phone payment system. For example, explore the OASA tram and bus system for opportunities to reuse components for the payment engine.
- Create spaces for motorcycle parking.

Expected outcomes
- The City of Athens has an ambitious programme of transformation that requires a change of culture and attitude from its citizens. Making it easier for people to comply with the existing regulations will help assure their support.
- Increased revenues from parking payments.

Cost of inaction
Continued illegal parking of motorcycles because of a lack of designated spaces. Increased congestion as people drive around the city looking for parking spaces because it is difficult to know where spaces are vacant.

Proposed owner and stakeholders	Suggested resources needed
Owners: Municipality, DAEM	Programme management, technology consulting, communications strategy, urban planning
Stakeholders: • Parking lot operators • OASA	**Cost estimate:** Medium — Parking spaces will have to be created or modified to accommodate motorcycles. Reuse could reduce costs if it's possible to use the OASA system and extend the current DAEM Smart Parking pilot.
Dependencies	**Key milestones, activities and time frame**
Collaboration with parking lot operators	**Short to medium term** • Review the DAEM pilot and recommendations as to how to take the programme further • Develop an appropriate strategy for electronic payments • Work with the private parking operators to create motorcycle parking spaces

Priority

High — Given the difficulties in finding and paying for parking in the centre of Athens, congestion and illegal parking, especially of motorcycles, is likely to continue. These difficulties need to be overcome, as introducing stronger enforcement without addressing these issues may risk alienating the people of Athens and its visitors, leading to cynicism and unwillingness to support the new vision of a city that offers an improved quality of life.

Experiences and case studies

The City of Westminster in London has a Smarter Parking deployment in which CCTV and sensor systems are used to control parking. A free app provides real-time information from sensors in more than 3,000 paid-for and disabled bays in the West End, helping locate an empty space as quickly and painlessly as possible. Features include live "red, amber, green" status for more than 3,000 spaces; locations of more than 41,000 on- and off-street parking spaces; filter parking bays by paid, disabled, residential, loading, taxi, motorcycle; satellite navigation to direct drivers to parking spaces; detailed information, including number of spaces, operating hours and tariffs; sort results by price, distance or rating; rate and share parking location details, and leave feedback; pay for parking and manage parking sessions.

Many cities now use CCTV for a number of purposes, and Liverpool, England, is just one example. City Safe uses CCTV to prevent criminal activity, protect property and help victims of crime; Parking Services uses CCTV to help ensure parking and bus lane laws are enforced; Premises Management uses CCTV to secure council buildings; Localities uses CCTV to help detect environmental offences; and Regeneration uses CCTV to monitor public spaces and provide security.

The City of Madrid provides a centralised CCTV operation. The aim of the system is to centralise in a single place to view and obtain recordings of all images available at the municipal police department through an application from which the operator can access all CCTV display footage.

2. Develop a comprehensive multimodal transportation strategy

The economic vitality of Athens depends on the ability of travellers of all types to access and move around conveniently within the historical and commercial centre. The mayor has set an explicit objective of reducing congestion and increasing the amount of space for pedestrians. This requires shifting travellers to increased use of public transit, limitations on car access and improvements to the streetscape to increase the appeal of walking. The opening of the Metro prior to the 2004 Olympics, along with the conversion of some streets to pedestrian-only walkways, has improved mobility. Nonetheless, Athens still is highly car dependent, with rising congestion, infrastructure in disrepair and a general lack of adherence to rules on use of public space. As discussed in the previous section, better enforcement of existing rules is paramount, but improvements in mobility also require new policies and programmes, along with significant investments in transportation infrastructure.

2.1 Define and ensure compliance with rules on parking for tourist buses

Rules on parking for tourist buses is a major area of dissatisfaction among key stakeholders. Tourist buses typically avoid driving through or dropping off passengers in heavy retail areas, such as Plaka and adjacent neighbourhoods, which is a missed opportunity for economic development and tax revenue generation. About 15 to 20 years ago, hundreds of tourist buses would drop off passengers in the Plaka area each day, but this is now rare due to conversion of some key arteries to pedestrian-only walkways, lack of agreement on drop-off and pickup locations and poor enforcement of illegal parking by taxicabs and private cars.

In other parts of the historical and commercial centre, tourist buses, taxicabs and public buses regularly compete for use of bus lanes, taxi ranks and public parking spaces, with disagreement on rules and poor enforcement resulting in disorder and poor accessibility.

In the IBM team's meetings with stakeholders, such as the Association of Athens Business Owners and the Athens Traders Association, priority was given to increasing access by tourist buses to the central district, without unduly restricting the mobility of other travellers. We heard specific ideas, which merit further study. For example, allowing tourist buses to enter Mitropoleos Street for drop-off and pickup; using Syntagma Square, areas outside the Acropolis and Omonia Square for drop-off and pickup; and allowing tourist buses to park in Metro garages, bus lots in Gazi or next to the National Gardens while waiting to pick up passengers. The mayor could convene a summit to hear these ideas and others and then commission further impact analysis by traffic engineers, with the objective of setting and ensuring compliance with new policies.

Recommendation 2.1: Define and ensure compliance with rules on parking for tourist buses

The City of Athens should engage with external stakeholders to agree on parking rules for tourist buses.

Scope and expected outcomes

Scope
The mayor could convene a summit to hear ideas from stakeholders and then commission further impact analysis by traffic engineers, with the objective of setting and ensuring compliance with new policies.

Expected outcomes
A set of rules that can be easily enforced

Cost of inaction
Inaction on this recommendation means an ongoing missed opportunity to increase revenues for local business and the City.

Proposed owner and stakeholders	Suggested resources needed
Owner: Deputy Mayor on Municipal Police and Sustainable Mobility **Stakeholders:** • Athens business associations • Tourist bus operators • Traffic Police • Municipal Police	Discussions with stakeholders to be led by Deputy Mayor or General Secretary, with support from the City Urban Planner and Traffic Engineer **Cost estimate:** Low

Dependencies	Key milestones, activities and time frame
None	**Short term (three months)** • Solicit proposals from stakeholders • Assess impact on traffic and other factors • Establish rules (within three months) • Communicate with stakeholders and the public

Priority

High — This is an opportunity to realise short-term benefits and generate support for the mayor's mobility agenda.

2.2 Improve pedestrian streets and prioritise additional streets for conversion

Currently, various streets in the commercial triangle and the Plaka neighbourhood are already restricted to limited vehicle access, generally for deliveries and waste management and sometimes for residential permit holders. Further, the Municipality recently approved a pilot programme to transform additional streets in the commercial triangle to pedestrian walkways. The programme will be implemented in the first half of 2016, with streets selected based on a law originally passed in 1995 (see Figure 9 for existing and planned pedestrian streets in the commercial triangle and adjacent neighbourhoods).
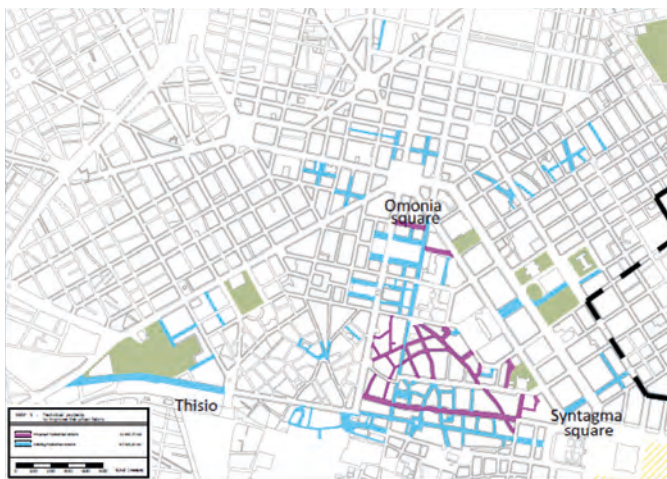

Figure 9: Existing and planned pedestrian streets

Efforts in Athens to reclaim public space for pedestrians is consistent with practices in cities across Europe, where it is common to limit car access in historical centres and central shopping streets.[8] Notable examples include car-free zones in all of Venice, most of central Copenhagen, the "Innere Stadt" of Vienna and the historical centre of Brussels. Copenhagen started more than 40 years ago by closing the main central shopping street to car access, converting additional streets to pedestrian thoroughfares, reducing the availability of parking spaces in the city centre and converting parking lots to public spaces.[9]

Leaders in Athens from both the public and private sectors generally agree that restricting car access has improved the quality of life in the historical and commercial centre and has had a positive impact on the retail and tourist sectors. The transformation of Ermou Street is a good example, as it is now the busiest shopping street in the city and a major destination for Athenians and tourists, many of whom arrive by Metro. Nonetheless, opportunities exist to improve accessibility and mobility on the existing pedestrian streets. For example, there is very limited disability access; signage is often missing, damaged or of poor quality; and no specific provisions are made for bicycles. Furthermore, there is only limited designated parking for motorcycles, resulting in illegal parking.

The Municipality should develop a short-term plan for improvements |to streets in the historical and commercial centre, focusing on investments that could be made in the next three years to increase mobility on streets already with limited car access. The Municipality should start with streets in the commercial triangle to achieve some improvements during the first part of 2016. As part of this initiative, Athens should identify additional streets for further conversion, with impact analysis and implementation planning undertaken as part of a long-term mobility strategy.

Recommendation 2.2: Improve pedestrian streets and prioritise additional streets for conversion

The City of Athens should develop plans to improve access to and expand pedestrian streets and prioritise additional streets for conversion.

Scope and expected outcomes

Scope

Various streets in the commercial triangle and the Plaka neighbourhood are already restricted to limited vehicle access, with plans just approved for more streets to be converted to pedestrian walkways. While the pedestrian streets have had a positive impact, opportunities exist to improve their accessibility. For example, there is no disability access, signage is often missing or of poor quality, no specific provisions are made for bicycles and there is only limited designated parking for motorcycles. The City should develop a short-term plan for improvements to streets already with limited car access, focusing on investments that could be made in the next three years. As part of this, Athens should identify initial candidates for further conversion, with implementation planning undertaken as part of a long-term mobility strategy.

Expected outcomes
- Improved access and mobility on pedestrian streets
- Increased public support for converting more streets to pedestrian use only

Cost of inaction

Potential reduction in public support for expansion of pedestrian streets in the commercial triangle already agreed for the spring of 2016

Proposed owner and stakeholders	Suggested resources needed
Owner: Deputy Mayor on Municipal Police and Sustainable Mobility **Stakeholders:** • Ministry of Infrastructure, Transport and Networks • Municipality of Athens • Athens business owners	Team with appropriate engineering and regulatory knowledge **Cost estimate:** Medium — Improvements in pedestrian streets will require investments in street-side furniture and other new infrastructure.
Dependencies	**Key milestones, activities and time frame**
Plans will require approval from national government	• Assess current state of pedestrian streets • Plan implementation of required improvements • Improve existing pedestrian streets in commercial triangle (add signage, bike racks and disability access, for example) • Improve additional pedestrian streets outside the commercial triangle • Set criteria for additional conversion; survey neighbourhoods to identify candidates

Priority

High — Significant opportunity exists to capitalise on investments already made to improve mobility in the city centre.

2.3 Establish a long-term strategy to reduce the use of cars

Metropolitan Athens is a dense, compact region that historically has been highly car dependent. Approximately four million people, comprising about 45% of the Greek population, are situated in a 412-square-kilometre area.

Investments and policy changes made in recent decades have had some impact in reducing congestion and improving accessibility. This includes development of the first ring road (Athenian Daktylios) in 1982; the policy of restricting access to the central district based on odd- and even-numbered license plates; conversion of some streets to pedestrian-only walkways within the commercial triangle; the development of the underground Metro, tram and suburban railway networks; and others.[10] The expansion of public transport as part of preparations for the 2004 Olympics had a particular impact, as car travel fell by about 6%.[11] Nonetheless, Athenians still exhibit a modal split that is highly skewed towards cars.

Transport mode	% of trips, Attica (2011)
Cars	52%
Public transport	38%
Walking	7%
Taxi	3%

Figure 10: Modal split, 2011, Athens region

In contrast, the share of trips by car is much lower in other European cities, with more walking, bicycling and use of public transport.[12]

City	Bike/walk	Public transportation	Motorised
Vienna	34%	37%	29%
Copenhagen	42%	30%	28%
Madrid	34%	40%	26%
Stockholm	45%	31%	25%
Helsinki	41%	34%	26%
Paris	55%	32%	13%
Berlin	39%	21%	40%
Barcelona	55%	31%	14%
Amsterdam	68%	11%	21%

Figure 11: Modal split, 2011, select European cities

Transportation planners from the Ministry of Transportation, Attiko Metro, OASA and the National Technical University all agree that traffic congestion will worsen in the coming decades without changes in mobility strategies. Although traffic congestion has declined in the past five years, this is mostly due to the overall decline in travel, stemming from the shrinking economy. In contrast, data provided by Attiko Metro to the IBM team indicates that the number of daily trips in the Athens region is expected to grow about 15% by 2030, with the share undertaken by cars staying at 52%. The impact of this is illustrated in the following maps, which compare the density of car traffic in 2011 with projections for 2030.

2030

Load of road network and level of saturation in high peak morning hours

Scale 1:50,000   November 2015

Legend

Vehicles/hour	Volume categories
− 250	V/C ≤ 0.7
− 500	V/C ≤ 0.9
− 1,000	V/C ≤ 1.0
− 2,000	V/C ≥ 1.0
− 3,000	Volume
− 4,000	Ring limit
− 5,000	

Figure 12: Projected traffic volumes in 2030

**Horizon 2011 –
current situation**

Load of road network and
level of saturation in high
peak morning hours

Scale 1:50,000   April 2013

Legend

Vehicles/hour	Volume categories
− 250	V/C ≤ 0.7
− 500	V/C ≤ 0.9
− 1,000	V/C ≤ 1.0
− 2,000	V/C ≥ 1.0
− 3,000	Volume
− 4,000	Ring limit
− 5,000	

Figure 13: Traffic volumes in 2011

To address this problem of growing traffic congestion, and to improve accessibility and mobility, the City should spearhead development of an overall multimodal strategy, focusing on reducing dependence on use of cars while making car travel more efficient. The strategy would cover a range of components.

Public transportation

Athens' public transportation network comprises three Metro lines, two tram lines, one Proastiakos (suburban railway) line and about three hundred city bus and trolley bus lines.

According to the National Technical University, Department of Transportation Planning, access to the city centre via public transportation is uneven.[13] It is good from certain directions, whereas from others, multiple transfers are required, linkages are broken or movement is impeded by traffic on arterial roads. Use of public transport increased following the opening of the Metro but has remained steady since 2006 as a percentage of total travel. The number of trips taken on public transportation has actually declined since 2011. This is consistent with the overall decline in travel and has mostly impacted bus travel and not the Metro.

Figure 14: Athens Metro lines

OASA, the public transport operating company (also known as Transport for Athens), receives significant government subsidies to cover operating expenses. Bus travel in particular has been impacted by cost-cutting measures, resulting in a reduction in routes and a large idle fleet capacity. OASA indicates that service quality also has been negatively impacted by poor maintenance of the bus stops, which is mostly outside their control, and by use of bus lanes by taxicabs and cars.

Attiko Metro and OASA have extensions to Metro lines 1, 2 and 3 planned or underway. Plans are in place to construct Line 4, but funding has not been secured. OASA plans to implement electronic ticketing across the various transit systems, including gates at Metro stations to reduce evasion. Additional OASA projects underway include redesign of bus stop signs and provision of real-time bus arrival information.

Road network
The IBM team did not complete a traffic analysis study, nor does it have the expertise to do so. Nonetheless, the Smarter Cities Challenge team notes the analysis of the National Technical University, Department of Transportation Planning, indicating that improvements are required along the peripheral roads of the city centre, in terms of traffic signalling adjustments, turning movements and prohibitions on parking, to assist the traffic along the ring roads as well as further discourage the entry of vehicles into the city centre. Ideally, Athens would develop a complex of ring roads with freeway characteristics to more-effectively channel through traffic. This is difficult due to practical and financial constraints, which highlights the need to more effectively use the ring roads that currently exist.

Parking
Shifting the supply of parking to outside the historical and commercial centre is a key element of making driving into the city centre less attractive. As previously discussed, it is important to improve the enforcement of rampant violations, which results essentially in a supply of "free" parking and a major incentive to drive. Illegal parking not only increases the volume of cars in the city centre but also adds to congestion when people have to drive around looking for spaces.

Better enforcement could make it more attractive to use public transportation and would shift demand for car parking to the lots outside the commercial triangle and on the outskirts of the historical centre. These lots currently are underutilised and could be made more attractive through discount programmes with retailers, development of park-and-ride stations and better service to the commercial centre by public transit. As enforcement improves, and the supply and accessibility of parking improves outside the centre, the City could consider reducing the number of legal parking spaces in the central district to further change the incentives for entering this area by car.

Taxis
There are nearly 14,000 taxis in the Athens region, about 4 per 1,000 inhabitants, whereas the European average is closer to 1 per 1,000. The large number of taxis is due to the fact that fares are relatively low, which creates a disincentive for using public transit. The presence of so many taxis in the city centre is a major cause of congestion and of the chaotic competition between cars, taxis and buses for access to parking.

Transform streets to pedestrian walkways
As part of the mobility strategy, an impact analysis should be conducted for any additional streets identified for conversion to pedestrian-only walkways. To achieve its mobility objectives, the Municipality should extend the number and length of streets that have limited or no vehicle access, and it should better connect these into an overall integrated network.

Bicycling
Bicycle use is growing in Greece, but currently there is limited accessibility for bikes in the historical and commercial centre. The number of bicycle stores and clubs has grown recently in the Athens region. Also, some municipalities have launched bike sharing programmes and networks of cycling lanes. This is largely in the northern suburbs, whereas Athens Municipality, particularly in the historical and commercial centre, lacks basic bicycling infrastructure. This is in contrast to other European cities, such as Amsterdam, Copenhagen, Vienna and Stockholm, where bike lanes, parking stations and sharing programmes are pervasive. The Municipality could start small with bike parking in strategic areas and painted lanes along a few key arteries.

Evaluation of other best practices

Athens could learn from programmes other cities have in place to reduce congestion. For example, some cities in Europe and Asia have a form of congestion charging, requiring motorists to pay a fee to enter or drive within a designated central area. Athens could consider revisiting the policy of limiting access to the city centre based on odd or even license plates. The boundary set for this policy may no longer be relevant given traffic patterns today compared to 30 years ago. Further, this policy is unevenly enforced and results in a large number of households simply buying a second car. Following Rome, Athens could require a permit to drive into the core central district, or at some point in the future the City could evaluate a usage-based charging scheme like those in London, Stockholm and Singapore.

Many cities also have programmes to promote ridesharing and teleworking. For example, some cities provide Internet-based ride-matching programmes and work with the private sector to offer car- and van-pooling services.[14] Given the large number of government departments located in the historical and commercial centre, Athens could work with the central government to promote teleworking for some employees.

Recommendation 2.3: Establish a long-term strategy to reduce the use of cars

The City of Athens should spearhead efforts to establish a long-term mobility strategy for the Athens region, encompassing investments in infrastructure and the adoption of new innovations and global best practices.

Scope and expected outcomes

Scope

Use of public transit has increased, but car congestion will rise without further investments and policy changes. To plan these, the Municipality should work with the Attica Regional Authority (Administrative Region of Attica) in developing a long-term mobility strategy for the Athens region, focusing on the following:

- Investments in public transit, such as expansion of bus routes, improvements to bus stops and bus signage, and securing funding for the planned expansion of the Metro
- Improvements to the road network to divert traffic from the city centre
- Measures to promote bicycling, starting with pilots and bike lanes in limited areas
- Measures to meet demand for parking outside the central district
- Reductions in the number of taxicabs allowed to drive in the city centre
- Implementation of additional conversion of streets to pedestrian walkways, along with expansion of motorcycle and bicycle parking
- Consideration of ridesharing, teleworking and congestion pricing

Expected outcomes

- Shift Athenians to greater use of public transit
- Reduce car traffic in the central district
- Improve the economic vibrancy and long-term sustainability of central Athens
- Increase the quality of life for residents

Cost of inaction

Without proactive measures, congestion will significantly worsen as the economy improves and the number of trips return to the historical norm.

Recommendation 2.3: Establish a long-term strategy to reduce the use of cars (continued)	
Proposed owner and stakeholders	**Suggested resources needed**
Owner: Mayor of Athens **Stakeholders:** • Ministry of Infrastructure, Transport and Networks • Ministry of Environment, Energy and Climate Change • Municipality of Athens • Attica Regional Authority	Deputy Mayor on Municipal Police and Sustainable Mobility, General Secretary, City Council members, experts in transportation planning and engineering **Cost estimate:** High — Many of the initiatives will likely require substantial investment in new infrastructure.
Dependencies	**Key milestones, activities and time frame**
Establishment of a forum to coordinate improvements to transportation across the Athens region (first step to establishing a Metropolitan Transportation Authority)	• Conduct traffic study • Assess road and transit capacity relative to current and future demand • Develop policies and investments to achieve desired modal shift • Identify initial areas of focus • Plan implementation program, including funding
Priority	
Medium — Implementation of this recommendation will have long-term impact but should build on other measures the City can more easily control, such as improving accessibility on the existing pedestrian streets, strengthening parking enforcement and establishing a cross-governmental transportation forum.	

3. Deploy intelligent transportation technology

In the City of Athens, residents face a multitude of challenges that impede the free flow of traffic throughout the city centre and the region as a whole. The causes are numerous. Most notable is the lack of coordination between all forms of transit that serve the community: Metro, tram, bus, trolley, train and roads. As a result, roads are congested in the city centre impeding efficient access to the historical and commercial centre for shopping, tourist and leisure activities.

Additional complicating factors are uncoordinated public works projects on roads and other pavements within and around the city centre. These activities, whether emergency repairs or planned upgrades, need to be communicated to municipal, traffic and public safety officers as well as waste management and sanitation staff. An example of how this lack of coordination caused disruption to city services was the breakage of the automated traffic signal system. This system had to be discontinued because 50% of the system was non-functional as a result of continuous breakage due to uncoordinated street projects. These negative side effects of blocked vehicle and pedestrian pathways created an unpleasant experience for residents, city employees and visitors to the area.

3.1   Deploy an Operations Centre to aggregate data and to monitor and coordinate mobility for Attica

As cities strive to become "smarter", they are implementing technology to become instrumented and interconnected, which enables the universal goal of becoming more intelligent. Operationally, cities are based on a number of core systems composed of different networks, infrastructures and environments related to their key functions. Each of these major systems needs to be interconnected to the others. Once systems are connected and data capture is normalised and operationalised, a "System of Systems"[15] is born that begins the evolutionary journey to becoming a Smart City, where predictive models and advanced analytics improve the operation and management of the municipal ecosystem.

Historically, these systems have lived in their own silos, where valuable information and data have been locked away, making it difficult to extract the potential discovery of how this information could be used in an aggregate manner to bring new awareness and intelligence to the operation of the city. Figure 15 is a representation of the various functions a city supports: administration, building and urban planning, environmental, energy and water, transportation, education, healthcare, social programme management and public safety. Naturally, these systems were born from different agencies and departments, which complicates the matter of integration. Data needs to flow between the various systems to provide timely levels of service to citizens.
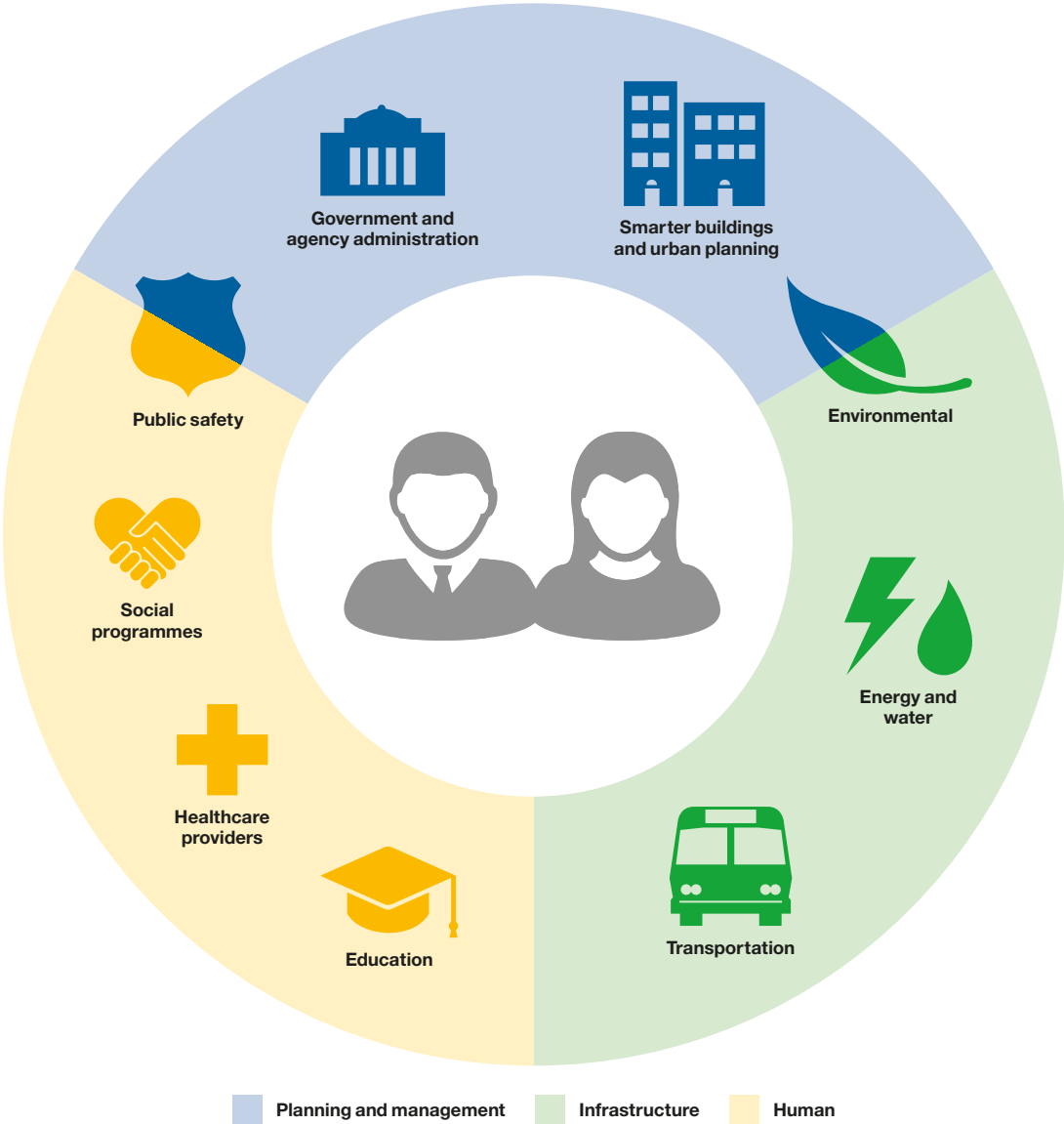
Figure 15: Typical city government functions

This technology helps government leaders manage complex city environments, incidents and emergencies with a city solution that delivers operational insights. It offers integrated data visualisation, near real-time collaboration and deep analytics to help city agencies enhance the ongoing efficiency of city operations, plan for growth and coordinate and manage response efforts. An Operations Centre provides integrated maps, online dashboards, customisable reports, multiple analytic algorithms, interactive standard operating procedures and other tools for improved city operations and incident or emergency response.

An integrated Operations Centre will help Athens do the following:
- Monitor and manage resources, events and incidents through geospatial situational awareness
- Stay connected with citizens and business owners to address their concerns through collaboration tools and services, thereby extending existing efforts to improve the customer relationship management (CRM) tools in place today
- Keep citizens safer with crime risk hot-spot analytics that can be shared through an easily accessible Information Hub and mobile application technology; hot-spot analytics can be used to visualise and report on areas where parking fines are most common and even display revenues generated from the areas using dashboard capabilities
- Integrate data from various departments and agencies through a common platform that enables coordination and awareness between departments — like public transportation, waste management, public works for road repairs and municipal, traffic and public safety officers — and includes a centralised dashboard for visualising parking availability in the area
- Take advantage of near real-time communication and collaboration among City agencies for more effective response management and coordination for disasters, incidents and planned events
- Combine reported problems with other sources of information to dispatch and schedule repairs, spot trends and optimise responses
- Bring data and systems together from various City departments and agencies using one common smarter city platform
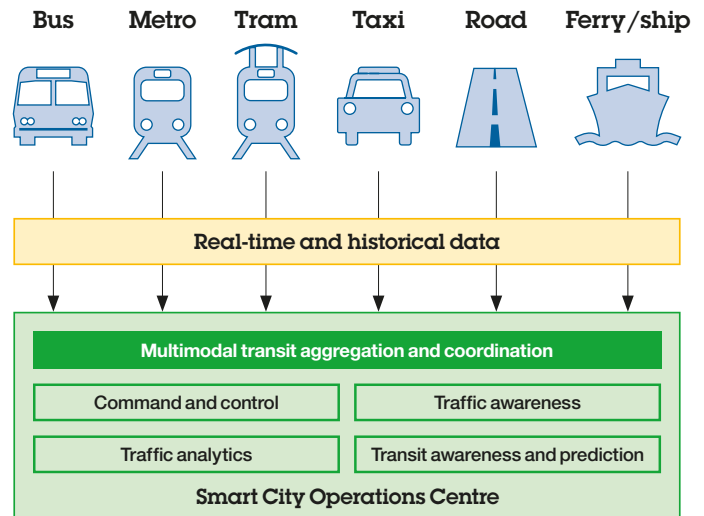
Figure 16: Integrated transportation Operations Centre

Recommendation 3.1: Deploy an Operations Centre to aggregate data and to monitor and coordinate mobility for Attica

The City of Athens should use intelligent transportation technology, deploying an Operations Centre to aggregate data and to monitor and coordinate urban mobility for Attica.

Scope and expected outcomes

Scope

As cities strive to become smarter, they are implementing technology to become instrumented and interconnected, which enables the universal goal of becoming more intelligent. An Operations Centre platform should perform the following:
- Aggregate data from independent systems
- Coordinate public works projects
- Integrate transit and mobility
- Connect with citizens through collaboration tools
- Consolidate municipal operations
- Provide executive dashboards
- Enable multimodal services for mobility
- Implement incident management for departments

Expected outcomes
- Improved congestion in the historical and commercial centre and throughout the Attica region
- Improved effectiveness of City services through electronic incident management
- Lower total cost of management through centralisation and shared resources

Cost of inaction

High cost of City service delivery, ineffective use of City resources, increased pollution due to mismanaged transportation services

Proposed owner and stakeholders	Suggested resources needed
Owner: Mayor of Athens	IT consulting, software, computing platform
Stakeholders: • OASA • Ministry of Infrastructure, Transport and Networks • Attica Regional Authority • Traffic Police • Public Works	**Cost estimate:** Medium to High — Requires system integration from each of the transit providers, Public Works, Municipal Police, Traffic Police and so on.

Recommendation 3.1: Deploy an Operations Centre to aggregate data and to monitor and coordinate mobility for Attica (continued)	
Dependencies	**Key milestones, activities and time frame**
• Redeployment of existing Regional Traffic Management System • Budget for implementation • Participation from the stakeholders listed above	• Identify order of integration by municipal system (road, Metro, tram, bus, parking, CRM, traffic management and so on) • Coordinate integration plan • Enable advanced modelling of multimodal transit flows • Develop executive dashboards for municipal executives
Priority	
High — This project will improve the overall effectiveness of transit management and municipal services in the city, and it will enhance the quality of life for residents and commercial interests in the Attica region.	

There are multiple cities around the world where this technology has been deployed to achieve the benefits described above. For example, Smarter Operations Centre technology is being used in the City of Minneapolis, Minnesota, to improve its overall operation. City officials are tracking more than 1,250 metrics and key performance indicators (KPIs) that support repairing potholes on city streets, improving transit systems, expediting snow removal and ensuring a safer city.[16] Minneapolis is leveraging data and analytics to improve the effectiveness and the efficiency of its operations.

Additionally, Quezon City in the Philippines and Montpellier, France, are using similar technology to address the following:
• Water management systems and coordination of failures
• Mobility and transportation
• Condition of buildings, roads and infrastructure
• Management of emergency services
• Advance warning for extreme weather events
• Provision of feedback from first responders on the number of casualties and affected families in natural disasters

For some additional examples, please refer to www.opticities.com, where the municipalities of Lyon, Madrid, Torino, Gothenburg, Birmingham and Wroclaw are described.

3.2 Redeploy and upgrade the Regional Traffic Management System

As previously mentioned, it is crucial to manage City services and transportation in a coordinated manner to optimise the flow of traffic in and around the city, enhance overall mobility, improve public safety, reduce environmental costs, such as pollution and fuel consumption, and create an environment that enables economic growth. Traffic management systems are required to support these goals. There are two systems deployed in Athens today: one with the Traffic Police, which is primarily used for public safety concerns, and the other, which is managed by the Attica Regional Authority.

In meetings with various stakeholders, the Smarter Cities Challenge team learned that the Attica Regional Traffic Management System has been shut down and is no longer being maintained. This system was implemented to support the huge influx of tourists at the time of the Olympic games in 2004. To detect traffic flows and inform drivers, there are numerous loop detectors, 75 video traffic detectors, 24 electronic traffic signs and 210 CCTV cameras deployed around the city on main roads and intersections. Operators use the CCTV cameras to view traffic conditions on a video wall that contains 42 individual monitors with rolling camera footage. Each camera is capable of being remotely controlled to zoom and pan the area nearby for visual inspection. At this time, the system is no longer being maintained and has been shut down. Many of the cameras are not functioning. In fact, the video wall is completely powered down and is not being monitored by traffic engineers or operations staff. The 24 electronic signs that are controlled by this system are also no longer functioning. These signs were used to display approximate time for traffic flow from one location to another based on current traffic conditions. The signs would also warn drivers of road blockages due to accidents or other emergencies impeding the flow of traffic. Drivers could make decisions to change their route if necessary using this information.

The system is responsible for monitoring and managing more than 2,100 signalised intersections in the Attica region. Ownership of the intersections is spread across the regional authority, the 51 local municipalities and the national Ministry of Transportation. As a result of austerity measures and the shutdown of the Regional Traffic Management System, there are only two traffic engineers to support the entire 2,100 intersections in Attica. These engineers cannot possibly respond to the numerous requests to add, modify and remove traffic signals in the area. We were told there is an average of one traffic engineer per 100 intersections in major European cities. Further research supports this claim: the US Department of Transportation suggests from five to 10 engineers per 1,000 traffic signals in addition to six other roles supporting the management of traffic lights, with up 51 additional staff required. Considering these numbers, there should be anywhere from 50 to 100 people supporting the traffic management system in Attica today.[17]

Once the Regional Traffic Management System is redeployed, it is essential to upgrade and enhance it with intelligent transportation management capabilities. Combined with the Operations Centre previously described, the regional and municipal authorities will be able to easily model traffic flows based on actual conditions and deploy real-time modifications to the flow of transit in the area. Currently, the system relies on historical information and predetermined scenarios that manage conditions based on models that are not enhanced and updated on a regular basis. Using advanced analytics with intelligent transportation technology will reduce the workload on traffic engineers and continuously improve traffic conditions in the area.

Recommendation 3.2: Redeploy and upgrade the Regional Traffic Management System

The City of Athens should redeploy and upgrade the Regional Traffic Management System, using intelligent technology for improved urban mobility.

Scope and expected outcomes

Scope
It is crucial to deliver transportation in a coordinated manner to optimise the flow of traffic in and around the city, enhance overall mobility, improve public safety, reduce environmental costs, such as pollution and fuel consumption, and create an environment that enables economic growth. Traffic management systems support these goals. The Attica Regional Authority has a Regional Traffic Management System that controls traffic flow in the City, but it has been shut down. This system needs to be redeployed and upgraded to include predictive analytics for traffic management.

Expected outcomes
- Reduced traffic congestion
- Reduced emissions
- Improved walkability in pedestrian areas
- Increased safety for bike traffic
- Enhanced public safety
- Improved conditions for economic growth

Cost of inaction
Inaction will lead to reduced economic growth, increased pollution, unpredictable traffic patterns and increased traffic jams in the historical and commercial centre.

Proposed owner and stakeholders	Suggested resources needed
Owner: Attica Regional Authority **Stakeholders:** • Mayor of Athens • OASA • Ministry of Infrastructure, Transport and Networks • Attica Regional Authority • Traffic Police	Funding for new equipment, operations contract, more traffic engineers **Cost estimate:** High — Requires upgrading and repairing existing traffic cameras and monitoring equipment, as well as hiring additional traffic engineers.
Dependencies	**Key milestones, activities and time frame**
• Budget for implementation • Participation from stakeholders • Hire new service provider to operate the Regional Traffic Management System	• Redeploy the existing Regional Traffic Management System • Repair broken infrastructure (cameras, loops, sensors) • Stabilise operations • Determine components for upgrade and replacement • Deploy intelligent, predictive analytics for traffic management • Integrate with the Operations Centre

Priority

High — This project will improve the overall flow of traffic in the city and enhance the quality of life for residents and commercial interests in the Attica region.

Some examples of benefits achieved by cities that are using predictive analytics for traffic management are listed below.

In Zhenjiang, China, they are transforming the public transportation system and using analytics technology to manage traffic patterns across the city:

- **Business challenge:** To bolster economic development, increase tourism and improve overall public welfare, the city initiated the "Smarter Zhenjiang, Smarter Tourism" project, which includes plans to replace and upgrade more than 400 bus stations and more than 1,000 public transportation vehicles.
- **Smarter solution:** In conjunction with the system-wide upgrade, Zhenjiang will rely on a predictive traffic management solution to provide city managers with a consolidated view of the transportation network, and the city will initiate a new bus scheduling system that will use analytics technologies to manage traffic patterns and more than 80 routes across the city.

The Dublin City Council improves traffic flow by using big data and analytics to predict bus arrival and transit times:

- **Business challenge:** To improve public transport services, Dublin City Council sought a way to dynamically monitor the movement of each of the city's 1,000 buses and better gauge if each one was operating on time.
- **Smarter solution:** The city deployed an intelligent traffic control solution that uses geospatial data from GPS-equipped buses to visually display the near-real-time position of each bus on a digital city map. Controllers can locate areas experiencing delays at a glance and instantly drill down to live camera feeds to identify root causes. Predictive analytics take into account speed, traffic flow and other factors to continually generate up-to-date estimates for bus arrival and transit times.

The City of Cologne, Germany, creates actionable insight from traffic monitoring data:

- **Business challenge:** The City of Cologne, Germany, wanted to find a solution that would help address its ongoing traffic congestion before it occurs, enabling it to take concrete action to improve traffic flow, alert and reroute drivers and even avoid traffic tie-ups altogether.
- **Smarter solution:** The City of Cologne piloted a traffic prediction tool that uses historical and near-real-time road-sensor data and a powerful first-of-a-kind algorithm to project and predict traffic patterns up to 60 minutes into the future. Knowing when and where congestion is likely to occur gives transportation planners the ability to take preventive action, such as resetting traffic light timing or modifying speed limits on certain roads, to keep traffic moving. The tool not only helps city traffic planners predict near-future traffic patterns but also automatically recognises and warns them of anomalies, such as an early start to rush-hour traffic or unanticipated congestion from an accident.

3.3 Deploy video analytics system

To support the goals of becoming "smarter" and more "intelligent", cities around the world are deploying video analytics technology to improve overall transportation management effectiveness and improve situational awareness for public safety. Enhancing existing CCTV camera deployments in Attica and deploying new cameras in the historical and commercial centre will enable multiple new capabilities that support the mayor's goals for revitalisation.

Video analytics creates a library of metadata from all video streams in the system. This metadata becomes a real-time and historical source of information for the City. Existing systems connected to the cameras are not interrupted. This allows the cameras to support multiple uses by different agencies for different purposes, thereby enhancing return on investment and consolidating resources.

Intelligent Video Analytics helps develop a model of coverage customised to the environment. It can identify perimeter breaches, as well as abandoned objects, objects removed and people and vehicle activity. An Intelligent Video Analytics framework also integrates specialised analytics, such as license plate and facial recognition. The broad capabilities of Intelligent Video Analytics fully complement and enhance an existing security infrastructure to provide defence against, as well as proactive understanding of, security vulnerabilities.

Below is a list of the potential features and benefits of a video analytics system:

Real-time alerts	Indexing and search
• Motion detection • Trip wire, threshold crossing • Object removal or abandonment • Counter flow detection • Facial capture • Facial recognition • License plate recognition • Combination alerts • Customised alerts • Crowd forming/running • Loitering • Directional motion	• Attribute-based search (size, colour, speed) • Date and time ranges • By location, in field of view • License plate search (partial or full) • Across multiple cameras • Track objects in view • Attribute-based search (time, duration) • Face search • Counting • Detect objects, scenarios, conditions in crowds

In Nairobi, Kenya, video analytics combined with Smart Operations Centre technology is being deployed to manage traffic congestion in what is considered the world's fourth most painful commute.[18] Mobile applications are being created to aid driver decision-making on route planning and travel time estimation through effective identification of traffic jams, accident reporting and emergency services dispatch.

Recommendation 3.3: Deploy video analytics system

The City of Athens should deploy a video analytics system for improved transportation management and better situational awareness.

Scope and expected outcomes

Scope

To support the implementation of intelligent parking, traffic and public safety systems in the city, a video analytics system should be deployed.

Video analytics allows the Municipality to protect roads and pedestrian spaces by detecting the following:

- Removal of objects (theft)
- Presence of foreign objects (such as waste)
- Pedestrian traffic volume
- Motor vehicles collecting (traffic jams)
- Counter flow of traffic
- Search for individuals of interest through facial recognition, colour of hats, coats, clothing and so on

Expected outcomes

- Event-driven identification of traffic violations in the region
- Remote monitoring and dispatch of police officers where needed
- Reduced manpower required for on-street enforcement
- Increased public safety
- Improved tourist experience

Cost of inaction

Inaction means reduced economic growth of the historical and commercial centre, encroachment on public spaces by cafes, vehicles and motorcycles, inability to control antisocial behaviour and ineffective parking management.

Proposed owner and stakeholders	Suggested resources needed
Owner: Mayor of Athens	Funding for new equipment, technology consulting and deployment
Stakeholders: • Municipal Police • Attica Regional Authority • Traffic Police • Public Safety Officers	**Cost estimate:** Medium to High — The technology is not hugely expensive, and the City can start small with critical areas, reuse existing cameras from the police and the Regional Traffic Management System.

Recommendation 3.3: Deploy video analytics system (continued)	
Dependencies	**Key milestones, activities and time frame**
• Budget for implementation • Participation from stakeholders • Operations support contract for new system	• Integrate with existing CCTV systems in the city and region • Identify required technology upgrades • Repair and replace cameras as needed • Deploy system • Integrate with the Operations Centre
Priority	
Medium — This project will improve the revitalisation of the historical and commercial centre and drive more economic growth, and these improvements are greatly needed to enhance the quality of life for residents and commercial interests in the Attica region.	

4. Cultivate public and private information sharing

The objective is to make Athens a Smarter City through the use of information sharing, encouraging citizen engagement through open data and other data best practices to improve the quality of life for citizens in the historic and commercial centre of Athens.

Findings

In the increasingly interconnected world, where data is considered the new natural resource, enabling data sharing with appropriate security is attaining paramount significance. While many of the information systems in the Municipality of Athens today are self-contained and serve the specific purpose they were originally designed for, opening up some of the data through mechanisms, such as APIs, could enable them to be used for other purposes. This could include analytics to provide insights and support decision-making.

Today there is a data explosion, as social networking media and a huge increase in the number of digital devices and sensors, connected through the Internet, generate unprecedented volumes of data. The City can tap into the Open Data movement, to develop innovative solutions, transforming Athens into an information-rich, sustainable and resilient city.

Information flows and sharing

The organisational complexity and number of agencies involved in the City of Athens creates a compelling case for cross-agency information sharing because many processes, such as the enforcement of parking fines, require data exchange between different municipal departments and the Ministries of Transportation and Finance (as previously described). Today, there is no real culture of information sharing, which results in data being trapped in silos. Developing an information sharing strategy, with the objective of automating data exchange where possible, will greatly improve process efficiency.

Innovation focus

There are encouraging signs that within Athens, a technology innovation culture is emerging. There is a recognition that an Open Data movement will fuel creativity and the production of systems that will add real value, such as information on parking, transportation, bike lanes, events and road closures. From the discussions with DAEM, ATC, INNOVATHENS and others, the IBM team has learned about many innovative pilot projects that have been initiated over the past few years. However, these have stayed at the pilot stage and have not been rolled into production status, which leads to the next recommendation — the Athens Information Hub.

Governance, quality and security of data

Data interoperability among systems that are fragmented in ownership is a key challenge. Practices for ensuring the quality, currency and security of systems data, through an appropriate governance mechanism throughout the information lifecycle, should be developed. As information systems proliferate through deployment of intelligent traffic management systems, CCTV and innovative systems, and as data becomes the lifeblood of the municipal operations, a focus on cybersecurity and data protection will need to be maintained. Establishing data standards, ontologies for common information exchange across systems and processes and adherence to standards, with the objective of ensuring quality and enhancing usability of information for common citizen services, is recommended.

Open Data for enhanced e-governance

The Open Data movement is spreading across the world, and it is a focus of the EU. The goal is to publish datasets that have broader value and can be used to generate new applications. This includes data generated by public- or government-funded research studies that would otherwise remain hidden in reports, with a goal to "democratise data". Other information sources from private organisations, such as transportation, weather and events information, can be combined. The data sets are made available for anyone to use, build upon, innovate and contribute back to the open community. The technology innovation that is developing in Athens will greatly benefit from a focus on Open Data.

1. Enable Open Data in Athens

While many of the information systems in the Municipality of Athens today are self-contained and serve the specific purpose of the stakeholders they were originally designed for, more can be achieved by enabling greater information flows and embracing the Open Data movement, which will transform Athens into a data-driven city, ready to embrace the challenges of future. Action items include the following:

- The Greek law on Open Data (4305/2014) has been in effect for just over a year now. Athens can enhance the Open Data programme as a model for public-private cooperation.
- The City can engage citizens through public data sharing from government agencies and EU studies and projects.
- Encourage private companies and citizens to build data apps on top of the public open-data platform and share the datasets for community usage, in line with worldwide Open Data movement best practices.

2. Create an Athens Information Hub

Create a platform to link and provide information that is of value to the City, its citizens, businesses and visitors. This will provide value to urban planners, government ministries, public transportation agencies, taxi organisations, tourists and businesses alike. The platform should do the following:

- Enable citizens to participate in data co-creation, as well as data sharing, with the help of academic, business and government agencies
- Enable a cross-agency transportation schedule and accrual of real-time data, allowing citizens to be better informed of transportation route planning and personalised options
- Bring in external data impacting Athens and its citizens, such as social media (Twitter, Facebook, Instagram, blogs and so on), weather and publicly available open data from economic research and publicly funded studies
- Provide data for the dashboards used by the Operations Centre

The City of Athens also should appoint a Chief Data Officer (CDO) who would oversee the information flows across existing and future systems and spanning agencies. The CDO should establish data-sharing norms via data integration, access and APIs. The CDO should also make Athens a safe data-driven city by establishing and enabling EU data protection and privacy norms by working with the Data Protection Agency (DPA). Additionally, the CDO should enable mobile access for all citizen-facing apps. Establishing a CDO will lead to the following benefits:

- Improved cross-agency processes
- Enhanced citizen services, such as multimodal transit information being accessible via mobile devices
- A sense of urgency to provide real-time city management information

Recommendation 4.1: Engage public and private businesses and citizens in cooperation through Open Data

Athens will become a data-driven city by engaging citizens and businesses through an Open Data movement.

Scope and expected outcomes

Scope

While many of the information systems in Athens are self-contained and serve the stakeholders they were originally designed for, more can be achieved by enabling greater information flows and embracing the essence of the Open Data movement. This will transform Athens into a data-driven city ready to embrace challenges with transparency, agility and citizen engagement.

Expected outcomes
- Enhance citizen services through use of available data
- Cultivate a sense of data-driven culture among citizens
- Enhance citizen engagement through the ability to share and create reusable Open Data
- Boost innovation and economic prosperity for citizens

Cost of inaction
- Information hoarding and inefficient information flows will continue to foster the waste of resources.
- Athenians will miss the opportunity of data-driven innovation and entrepreneurial opportunities, while Open Data movement is embraced by smart cities around the world.

Proposed owner and stakeholders	Suggested resources needed
Owner: Mayor of Athens **Stakeholders:** DAEM, ATC, OASA	Small amount of funding to promote Open Data movement and encourage open technology projects and entrepreneurship in Athens **Cost estimate:** Low — The Open Data movement is already working well for many European cities, with a history of EU-funded efforts in this space. It is a matter of reviving and giving it a boost through top City officials in Athens.
Dependencies	**Key milestones, activities and time frame**
A commitment of a small budget to sustain this programme for at least five years	**Short to medium term (first half of 2016)** • Establishing the open-data programme in Athens as a model for public-private cooperation • Engage citizens through public data sharing from government agencies and EU studies and projects • Boost innovation through API and data-driven initiatives **Medium term (second half of 2016)** • Encourage private companies and citizens to build data apps and share the datasets for community use in line with worldwide Open Data movement best practices

Priority

High — It is essential that the citizens of Athens capitalise on economic opportunities and engage with the Open Data movement.

Recommendation 4.2: Engage with inter-agency stakeholders to enable real-time information hub

The City of Athens should engage with inter-agency stakeholders to enable smooth flow and availability of real-time information across systems.

Scope and expected outcomes

Scope

Various agencies are involved in the City of Athens, with jurisdiction differing from country to region or prefecture to city level, yet the flow of information is either missing or follows a slow/manual process that impedes regulation enforcement, introduces potential for process breakdown and causes a culture of repetitive violations. Multiple agencies creating their own systems are generating data that remains in silos. An integrated application management system that enables an end-to-end view is missing and is needed urgently.

Expected outcomes
- Parking enforcement will be improved.
- Citizen services will be enhanced through available multimodal transit information flows accessible via the Internet.
- A sense of urgency to provide real-time City management information will be cultivated.
- Athens becomes a smarter city through the use of information sharing and real-time information to aid mobility and sustainability.

Cost of inaction
- Data remains in silos. Information hoarding and inefficient information flows will continue to foster the waste of resources.
- Regulation enforcement will be impeded with potential for process breakdown.

Proposed owner and stakeholders	Suggested resources needed
Owner: Deputy Mayor **Stakeholders:** • DAEM • OASA	Funding needed to establish CDO to start engaging inter-agency informational flows and establish Athens Information Hub (AIH) **Cost estimate:** Medium — While creation of a CDO position will be the first low-cost yet impactful step, enabling multimodal information flows in real time through the Athens Information Hub requires coordination and some cost to make it citizen friendly.
Dependencies	**Key milestones, activities and time frame**
• Budgetary commitment to sustain this programme for at least three years • Brokering collaborative coordination between involved agencies	**Short to medium term (first half of 2016)** • Creation of a CDO for Athens, overseeing the information flows across existing and future systems spanning agencies (first half of 2016) • Establish data sharing norms via data integration, access and APIs (second quarter, 2016) **Medium to long term (first quarter of 2017)** • Create an Athens Information Hub (AIH) (first quarter, 2017) • Make Athens a safe data-driven city by establishing and enabling EU data protection and privacy norms working with the DPA (first quarter, 2017) • Enable mobile access for all citizen-facing apps (first quarter, 2017)

Priority

High — It is essential that the citizens of Athens benefit from a data-sharing culture, and real-time information availability will make their lives better.

5. Engage Athenians on the transportation vision through multimedia

It is essential that the citizens of Athens have a clear understanding of the following:

- Why the mayor is taking steps to reduce congestion and reclaim public spaces in the historical centre
- How he plans to accomplish this
- What impact (positive and negative) this will have on those living, visiting and working in the city centre

There are many approaches one can take for engagement. The broader message might focus on tapping into the same pride that Athenians displayed during the 2004 Olympics. This is about returning the city centre to the people. It's important to paint a clear vision for improving how people will flow to, from and within the historical centre. Establishing a connection between what the City says and does is necessary to build credibility.

Although the specific elements of this initiative for Athens are unique, similar multimedia awareness communication plans have been effectively executed in other cities that have historical and pedestrian centres, like Amsterdam, Vilnius, Malaga, Kyoto and Stavanger.

For example, in 2004 the City of Amsterdam launched a campaign "I amsterdam" (Figure 17). The position of Amsterdam as the national cultural capital and major international cultural centre had been threatened by a sharpening of competition from other cities. The result of effective engagement will be more visitors, more companies and more residents.

Figure 17: I amsterdam

Multiple groups are directly impacted by this revitalisation effort, and each needs to be specifically targeted with a clear message and call to action. Geographically, there are two logical super-groups:

1. Inside the historical centre
  – Residents living within or near the centre
  – Business owners based within the centre and their employees
  – Delivery and removal services (commercial and private) serving the centre
  – Taxi and tour bus services in and around the centre

2. Outside the historical centre
  – Residents of Attica living outside and commuting into the centre
  – Tourists commuting to and from the centre

Based on the many interviews conducted with stakeholders, it is clear that many of the current challenges (illegal parking, incorrect use of pedestrian zones, lack of adherence to service delivery and pickup times, encroachment of cafes on public spaces and so on) are traced to a lack of understanding of regulations.

To implement the plan, a deeper analysis around media consumption habits is key (TV, radio, outdoor, direct mail, association meetings and social channels, for example) as well as an understanding of the media sources they trust (peers, social figures, non-governmental).The IBM team is aware of the cultural resistance many have to working in partnership with the government, so this needs to be taken into consideration as well. Below is some relevant mobile and social media market data on the Greek population to consider while developing the campaign:

- Mobile smartphone penetration is approximately 40% (54% iOS, 45% Android)
- Greeks spend more than 80 minutes per day on social networks.[19]
- Currently, there are about four million Facebook users in Greece, with a penetration of about 36% of the population.[20]
- Facebook and LinkedIn are the most widely used social media amongst workers, with a penetration of 90% and 63%, respectively. [20]

Recommendations

1. Execute the launch of an awareness campaign
It is important to fully fund the campaign through 2018, as the behaviour change needed to support the city centre is going to be a long journey. It is also important to take into consideration those that support the multimodal transportation vision (adhering to parking rules, waste removal and respecting public spaces).

2. Establish a social initiative to listen to and engage with the public
The IBM team recommends that the next phase of the campaign should engage the public in two-way dialogue. The strategy needs to do more than just inform the public; it needs to demonstrate how the City is actively listening. The best way to create this platform is through social media.

The campaign landing page should include a clear "call to action" on how to engage. This can be done through the Municipality of Athens Twitter account and Facebook page. However, the current Facebook page needs a news feed section, where topics are posted and discussed. These social-engagement sites also need to be managed and staffed. Typically, in many public and private organisations, social sites like these begin as someone's "night job", but to effectively update, analyse and respond to the public, this role should be formally staffed either at the ministry level or within an agency.

Social media analytics tooling helps municipalities track the overall sentiment of the public based on their online activity and posts. Real-time adjustments are made based on this input to make the campaign more effective (for example, use crowd-sourced voting to identify campaign focus topics).

It is also important to engage groups already established and aligned to the same goals of improving the quality of life for Athenians.

synAthina, an initiative of the City of Athens and one of the winners of Bloomberg Philanthropies "2014 Mayor's Challenge", is a prime example. Its mission is supporting and facilitating groups of citizens who seek to improve the quality of life in Athens through various actions. They have a platform to establish a connection between the dynamic involvement of the public and the local authorities. synAthina seeks common solutions to improve quality of life by upgrading the services offered by the City with a view to more-efficiently meet the ever-increasing needs of the citizenry.

The following are two examples of ministries and associations that can be engaged as well:
- **OASA** has developed an Internet and social media "Transport for Athens" campaign with a wide range of tactics targeted at the youth of the city. Transport for Athens obtained a page on Facebook and a YouTube channel. Additionally, they held a photo contest to further promote the use of public transportation.
- **MEDNETA** is an association that partners with five similar cities across the Mediterranean to enhance cross-boarder cultural dialogue and cooperation among crafts store owners as a means of regenerating these historical communities.
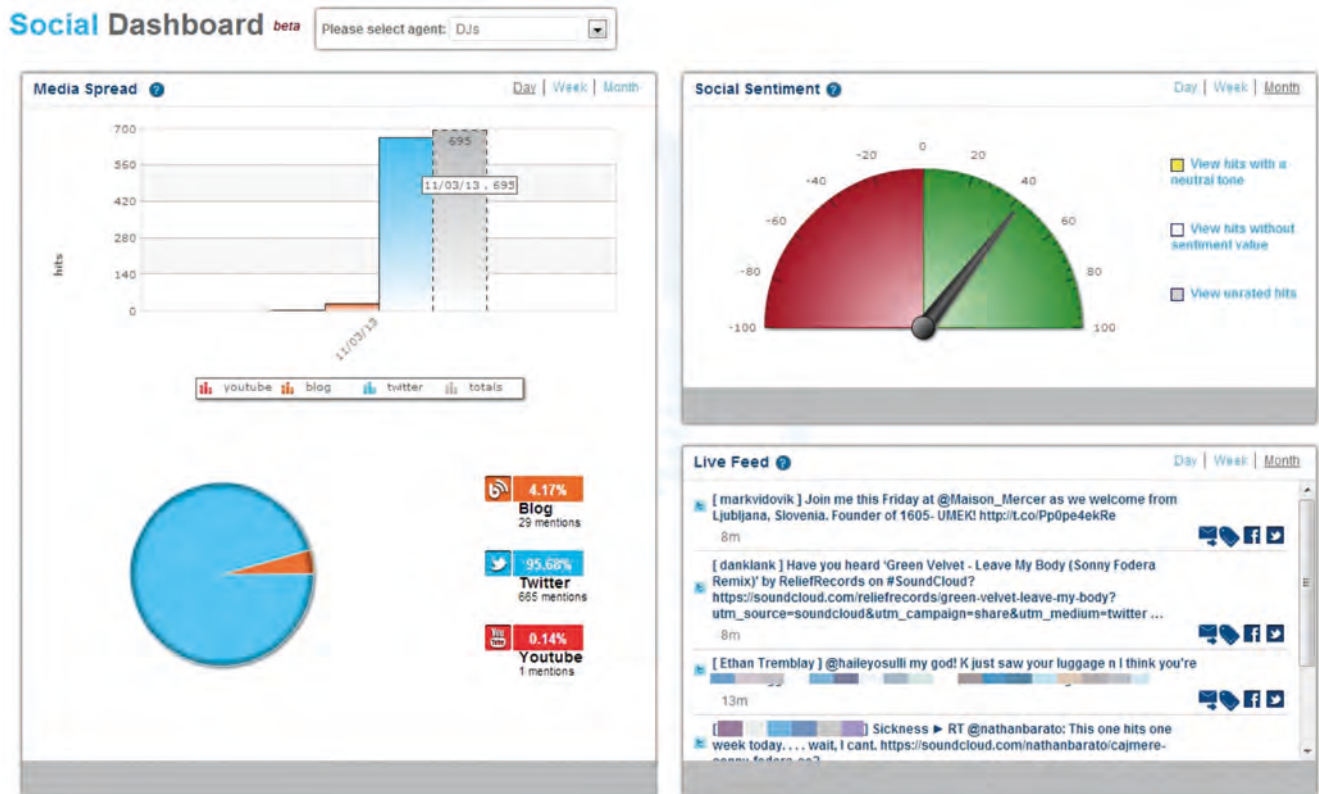
Figure 18: Sample social sentiment dashboard

3. Deploy interactive "mood kiosks" across the city

It is clear that many Athenians have a desire to express themselves, often through graffiti, which covers much of the city centre and significantly draws away from the historical charm it once had. Changing this behaviour is going to take time. Providing outlets for the community to express itself is a way to start. The social sites previously mentioned are one example. Another is through the use of interactive kiosks. These kiosks are multi-functional and provide useful information about the city, like interactive maps for historical sites, shops, restaurants, events, as well as a unique application that measures the public mood and sentiment (see Figure 21).

The data from each engagement can be collected and aggregated to calculate the collective mood of the city each day. This mood can then be projected onto a public space like the Athens Town Hall (see Figure 22) or to light up the fountain in Syntagma Square (see Figure 23)

Figure 22: Example lighting up Town Hall to honour the victims in Paris on November 13, 2015

Figure 21: Example of a "mood kiosk" considered by the city of Helsinki

Figure 23: Example of lighting up the fountain in Syntagma Square

Finally, ongoing tracking of the campaign progress includes indicators, such as the following:
- Number of citizens with awareness of the vision for the historical centre via online polling
- Number of citizens participating through social channels on the progress and challenges remaining through dashboards
- Real-time feedback from tourists through social applications, public engagement and sentiment analysis tools and interactive kiosks
- Regular feedback from the local businesses and trade associations

Recommendation 5: Launch a campaign to engage the public to help reduce congestion and reclaim public spaces

Engage and empower the public to support the efforts to reduce congestion and reclaim public spaces.

Scope and expected outcomes

Scope

A 360-degree campaign to reach every possible audience will use a combination of media channels. It will be necessary to govern tracking models (reach, frequency, social sentiment and media impressions, for example) and conduct periodic reviews to share results and agree on necessary adjustments. Varying groups will each need a clear message and call to action. A deeper analysis is needed to understand media consumption habits (TV, radio, outdoor, kiosks, direct mail, committee meetings, social channels and so on) and trusted sources (peers, social figures and non-governmental influences, for example).

Expected outcomes
- Increased commerce — As citizens embrace the regulations, the flow of traffic and pedestrians will improve, increasing the volume that can be serviced daily.
- More people = more commerce — This can be tracked with a baseline set.
- Reduced enforcement costs — As citizen behaviour changes to adhere to legal parking, use of public transportation will increase, taxis and tour busses will adhere to pickup and drop-off zone laws and fewer resources will be needed for enforcement.

Cost of inaction

The full extent of the mayor's vision for the city centre will be at risk without the active involvement of citizens.

Proposed owner and stakeholders	Suggested resources needed
Owner: Deputy Mayor on Municipal Police and Sustainable Mobility **Stakeholders:** • DAEM • Associations of tourism and commerce	**Cost estimate:** Medium — Although the final campaign budget is still being finalised, it will be a significant investment spanning multiple media channels to effectively reach the population.
Dependencies	**Key milestones, activities and time frame**
A commitment of the budget to sustain a three-year campaign	• Launch campaign (Q1) • Establish social media engagement site, staffing and measurement tools (Q2) • Deploy mood kiosks around the city centre (Q3)
Priority	
High — It is essential that the citizens of Athens understand the broader transportation strategy and actively participate in its success.	

6. Set the foundation for a Metropolitan Transportation Authority

The City of Athens wants to develop a vision towards "smart transportation management and a long-term strategic plan for sustainable mobility." This requires strong cross-functional and cross-governmental coordination of ideas, projects, stakeholders and beneficiaries. Mobility is a theme, which has interconnections with many other vital areas (environment, governance, economy, quality of life) in any municipality and should be developed in a holistic manner. Currently there is no single point of responsibility for the mobility strategy in the City of Athens.

Policy regulation and implementation for transport and mobility are split across a number of different organisations and different administrative levels (national, regional, local). Even within the same administrative body, such as the Municipality or ministry, there may be many departments handling small pieces of the same process and acting in a "siloed" mode. Sources of data are different, and processes and management tools are fragmented.

As a consequence, the task to effectively *"develop a short-term roadmap for smart transportation management [and] a long-term strategic plan for sustainable mobility"* is complex.[21] The creation of a single strategic plan and effective execution requires excessive consultation.

The Attica region has 50+ municipalities, including the City of Athens, each of them with a certain amount of jurisdiction covering parking enforcement and maintenance of small roads and pavement.

There is also a regional government (Attica Regional Authority) responsible for the regional roads and big arteries connecting the towns and crossing them. Attica Regional Authority is responsible as well for some of the signalisation activities in the city, such as intersections, and the maintenance of the traffic lights.

Above the prefecture, the Ministry of Transportation dictates central guidelines for any transportation means (cars, bicycles and so on) and is accountable for issuing general laws and specific regulations related to the road network for which they are responsible. Attica Metro and OASA also are part of the Ministry of Transportation, with responsibility for developing and operating the Metro, bus and rail networks. Both the Attica Regional Authority and the OASA operate transportation control centres, as do the private companies that have concessions to manage the toll motorways in the region.

While this is the complex contextual framework for many cities around the world, the City of Athens has to struggle with developing an integrated strategy in the presence of additional public and private agencies, and the requirement to address many diverse needs through a fragmented channel, which leads to confusion and unclear legal and operational scenarios for its own agencies and its citizens.

Ultimately, the public administration must ensure that public decisions are taken in an open and transparent manner and are informed, interconnected and backed by the comprehensive involvement of the relevant stakeholders. There is a clear need for agility, accuracy, real-time information and excellence in delivery, regardless of whether it comes from the central, regional or local administration.

The Smarter Cities Challenge team recommends the creation of a cross-agency Programme Board accountable for the end-to-end governance of initiatives related to smart transportation and sustainable mobility. The Programme Board will be the mechanism to execute and operate in a more flexible and coherent manner with respect to all topics related to this area. This will help to build effective relations across levels of government, to apply economies of scale, increase effectiveness — mostly at local level — and capitalise on synergies.

There are multiple examples of government programmes of differing kinds that have been undertaken through the adoption of horizontal and multilevel structures in line with OECD recommendations[22] and EU "Better Regulation" principles.[23]

The January 2014 study about "Mapping Smart Cities in the EU"[24] also foresees the creation of a central office as one of the three important factors for successful smart city programmes.
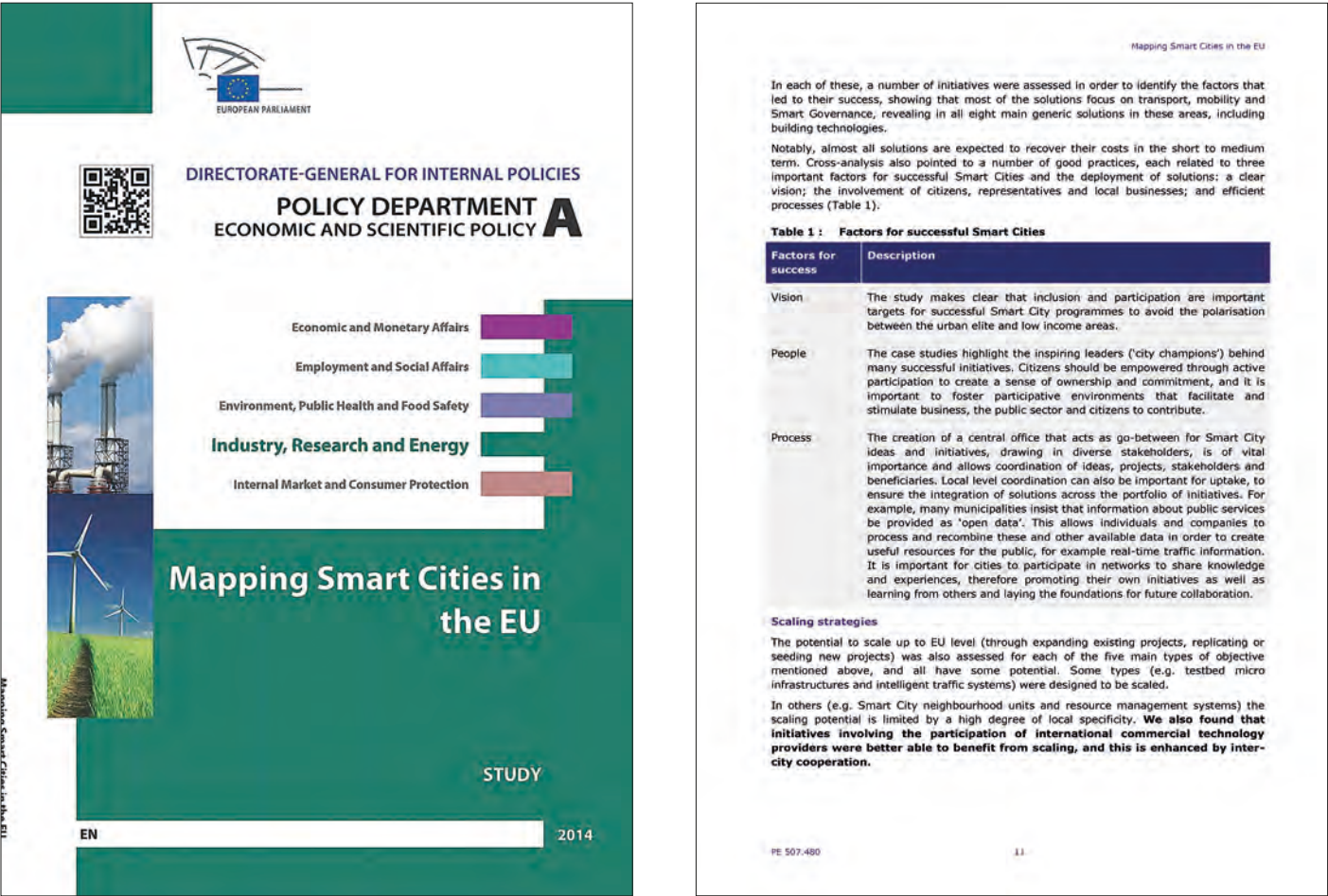

Figure 24: Factors for successful smart cities

The cross-agency Programme Board

The Programme Board should be a team made up of individuals from different departments within the same administration level (mobility, IT, finance, police) and individuals from different administration levels (national, regional, local), thus creating a long-term agency that is relatively isolated from political changes.

Mission

The Programme Board should be accountable for the end-to-end cycle: from strategy design and preparation to implementation and operation, including monitoring, measurement and revision. The IBM team recommends the use of quality improvement methodologies such as PDCA/PDSA (see Figure 25).[25]
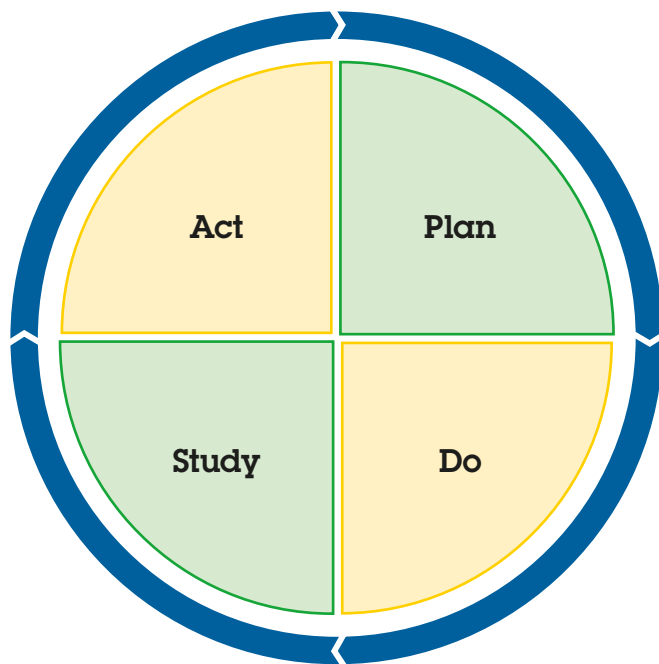
Figure 25: Deming Cycle

Goals

The primary goal of the Programme Board will be to improve effectiveness of local public services in relation to smart transportation and sustainable mobility, as well as implementation of development strategies, applying best practices aligned to industry standards.

Metrics

The Programme Board should operate a set of metrics to measure success and progress towards the agreed goals. The selection of KPIs relies on a common agreement of what success means for the agency and the identification of potential improvements. The IBM team recommends the following two high-level categories of KPI:

1. KPIs measuring the performance of the agency itself, establishing performance indicators usually associated with service level agreements (SLAs) or service quality. Examples include percentage of incoming requests resolved within an agreed-upon or acceptable period of time, cycle time from request to delivery, number of complaints received within the measurement period and so on.
2. KPIs measuring certain criteria associated with execution of programmes initiated by the office, such as the implementation of the Information Hub or a mobile parking payment system.

These KPIs are displayed and aggregated on the dashboards provided by the Operations Centre described in Recommendation 3.1.

Resources and management system

There are several organisational models that could be used to create the Programme Board, and which model is selected depends on a wide range of factors, such as cultural imperatives or existing organisational structure. One of the most important decisions is the level of empowerment and involvement on concrete actions that the members want to assign to the Programme Board, as this is key to achieve the targeted level of effectiveness.

Based on the findings, the IBM team recommends creating a model aligned with the mission of the Programme Board, giving it ownership for driving all projects, from strategy, design and preparation to implementation and operation. It should also be accountable for monitoring effectiveness

and revising plans where necessary.

The Programme Board should be empowered to review scope, allocate resources and validate estimates of time, budget, risk, impact assessments and associated KPIs before the project is undertaken. At a later stage, the Programme Board should withdraw from close project management and focus more on strategy rather than on tactics, as well as on a continuous improvement methodology for designing long-term strategies. However, in the early stages, while the Programme Board is maturing, the IBM team sees value in direct engagement at all stages of the programme lifecycle.

The cross-governmental Programme Board that would be set up to manage smart transportation and sustainable mobility initiatives in the Athens region should include a representative from the following organisations:
- The Ministry of Infrastructure, Transport and Networks
- The Ministry of Environment, Energy and Climate Change
- The Transportation Department of Attica Regional Authority
- The Municipality Sustainable Mobility Department
- The Municipality (Environment and Energy Department)
- OASA
- The City IT Department and/or DAEM

The Smarter Cities Challenge team suggests the permanent committee report into the Attica Regional Authority and be in charge of assuring the coherence in mobility policy, design and implementation through the engagement of the institutions that they represent. Other relevant stakeholders, both public and private, should be invited regularly to ad hoc meetings. The appropriate legal mechanisms for the enforcement of the agreed decisions should be applied.

Change management system
The IBM team also recommends the use of a change management system to impose a systematic approach to dealing with change in a proactive manner, defining and implementing procedures to respond to changes driven by new requirements or policies.

Conclusion
The Municipality should approach smart transportation and sustainable mobility in an integrated and holistic manner, with the aim to proceed with a long-term sustainable strategy for the incorporation of a cross-governmental Programme Board acting as a Metropolitan Transportation Authority.

However, there are many possible projects (see the roadmap on page 10 of this report) out of the Smarter Cities Challenge team's core recommendations that could be deployed with real value for the city and serve simultaneously as pilots or starting points to proceed with the development of a more ambitious long-term strategy, which would not require the Metropolitan Transportation Authority to be already incorporated.

Changing the "modus operandi", looking for an interconnection of human capital, social capital and technology in order to generate greater and more-sustainable economic development, is a value in itself, whether applied to specific projects or broader initiatives.

In view of the challenges that incorporation of a Metropolitan Transportation Authority presents, the IBM team recommends to start changing the modus operandi at the Municipality level, through the adoption of a systemic approach to ensure that the smart transportation and sustainable mobility vision is consistent across the whole organisation.

This change will require the appointment of a Municipal Project Leader empowered to coordinate the end-to-end project activities and accountable for its success. This figure should also apply above described methodologies and processes for the proper operation of the Programme Board.

Figure 26: Building a case for change: A nine-step model for sustainable development leadership in the public sector[26]
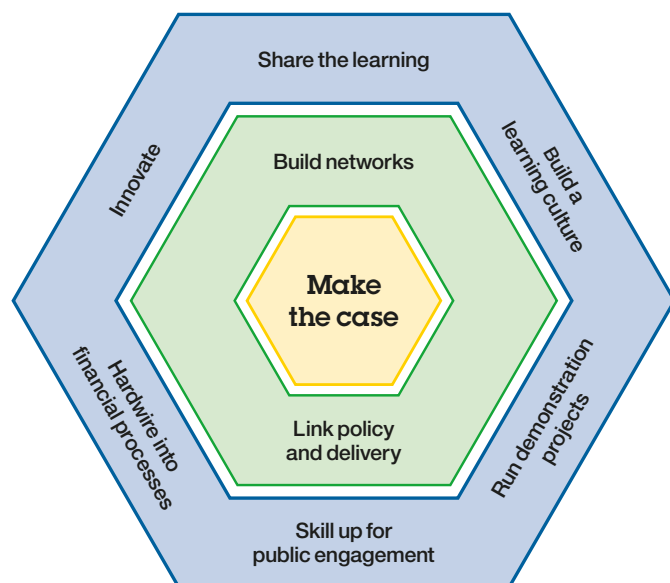
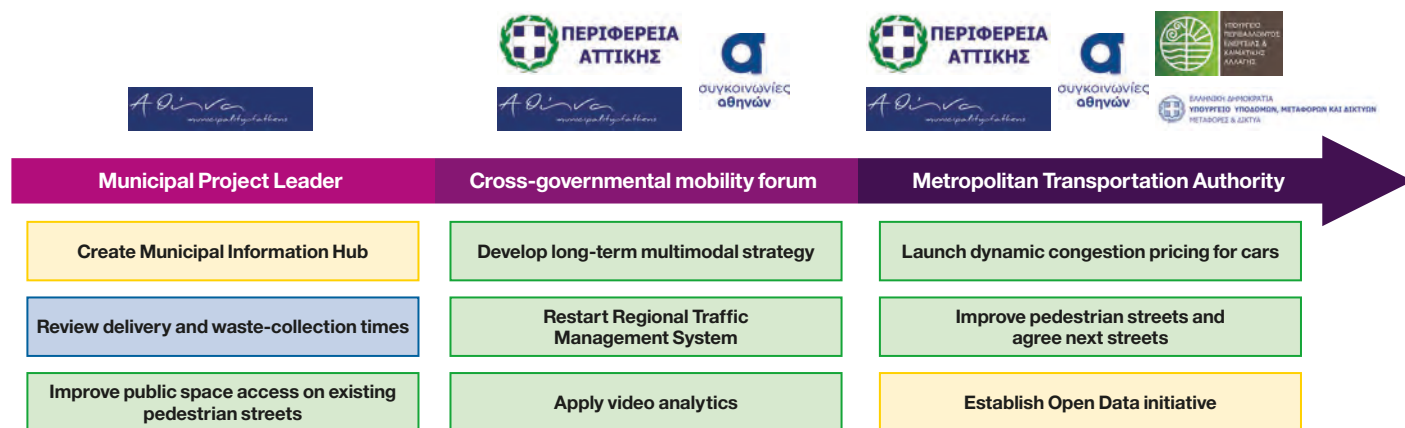A further step in the adoption of a smarter governance approach for smart transportation and sustainable mobility will be the incorporation of a cross-governmental mobility forum, sponsored by the Municipality and involving other agencies, like OASA and the Attica Regional Authority. This forum should be a consultative body to give advice to the Municipality on the implementation of mobility initiatives. The IBM team considers this forum an important mechanism for the definition of the future smart transportation sustainable mobility strategy and its implementation in a broader perimeter of the city and the region. It will be a tool to call other relevant stakeholders to give their views on the initiatives and strategy through a proactive approach. It will also form the basis for the incorporation of the recommended Programme Board to act as a Metropolitan Transportation Authority.

Municipal Project Leader	Cross-governmental mobility forum	Metropolitan Transportation Authority
Create Municipal Information Hub	Develop long-term multimodal strategy	Launch dynamic congestion pricing for cars
Review delivery and waste-collection times	Restart Regional Traffic Management System	Improve pedestrian streets and agree next streets
Improve public space access on existing pedestrian streets	Apply video analytics	Establish Open Data initiative

Figure 27: Example of a smart transportation and sustainable mobility governance journey for the City of Athens

Recommendation 6: Align governance with goals

The City of Athens should spearhead increased cross-governmental coordination in management of transportation across the Attica region.

Scope and expected outcomes

Scope

Based on best practices and EU and OECD principles, the Smarter Cities Challenge team recommends the creation of a cross-governmental entity responsible for the end-to-end smart transportation and sustainable mobility policy for Athens. This entity should report to a higher governmental organisation and engage other relevant stakeholders, whether public or private, calling to regular meetings and using the appropriate legal mechanisms to enforce decisions. Initially, the entity could be formed as an ad hoc Programme Board, with initial successes leading eventually to the creation of an Athens Metropolitan Transportation Authority.

Expected outcomes

- Increased effectiveness in strategy development and execution
- Application of economies of scale
- Capitalised synergies
- Avoidance of regulation gaps or overlaps
- Increased citizen satisfaction

Cost of inaction

Responsibility for different transport modes is divided between national, regional and municipal governments, so no government entity can achieve its objectives without cross-governmental coordination.

Proposed owner and stakeholders	Suggested resources needed
Owner: Mayor of Athens **Stakeholders:** - Attica Regional Authority - Ministry of Infrastructure, Transport and Networks - Ministry of Environment, Energy and Climate Change - Deputy Mayor on Municipal Police and Sustainable Mobility	Involvement of officials with responsibility for transportation at the different levels of government **Cost estimate:** Low

Dependencies	Key milestones, activities and time frame
None	- Appoint a Municipal Project Leader - Build the management system (space, resources, cadence, KPIs) to run the projects/initiatives - Empower the Project Leader and communicate regularly - Create a cross-governmental mobility forum - Use the Athens Information Hub as a tool to reach the goals and further develop the mission - Build on success to expand the authority of the cross-governmental body

Priority

High — Development of a long-term strategy to reduce congestion and improve mobility in the region requires a mechanism for cross-governmental coordination.

5. Conclusion

Athens is one of the oldest cities in the world. It has a unique place in human history as a pioneer of the arts, philosophy, theatre and democracy. Athenians have rightly acquired an almost legendary status. This pride is, and must continue to be, reflected in the historical and commercial centre of the city.

The IBM Smarter Cities Challenge team's recommendations focus on the most strategic opportunities to reduce congestion and improve the quality of life in the city centre. Foundational to these recommendations is the assumption that all stakeholders will participate and share accountability.

Thanks to many well-coordinated initiatives in advance of hosting the 2004 Olympic games, there is a significant transportation and technology infrastructure in place, as well as evidence that the citizens of Athens can collectively support a common vision. However, there is opportunity to further coordinate the City's efforts around a new vision with supporting policies and an execution plan. To achieve this, it is essential to set clear objective targets for each of the recommendations detailed in this report.

Implementing the IBM team's recommendations will achieve both qualitative and quantitative benefits for the city centre. Qualitative benefits include improved pedestrian flow, increased access to public spaces and reduced traffic congestion. Quantitative benefits include the reduction of carbon emissions, a more financially viable transportation ecosystem, a thriving business economy and growth in tourism and tourist satisfaction.

The Smarter Cities Challenge team would like to thank the City and citizens of Athens. Both have helped immensely by giving their time, insights and information that were used to produce these recommendations. Collectively, the IBM team feels a personal and ongoing bond with Athens' vision to reduce congestion and improve the quality of life in the city centre while maintaining its rich cultural heritage.

6. Appendix

A. Acknowledgements

- Karolos Kostopoulos, B' Vice President of Athens Traders Association
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- Stefania Frarou, Vice President B, Association of Athens Business Owners on Tourist Areas
- Christos Thalassinos, Board Member, Association of Athens Business Owners on Tourist Areas
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- SATA (Taxi Drivers Union of Attica)
- Food Businesses Penalty Notices Department, Commerce and Development Administration
- On-street controlled parking fees and parking tickets payment department, Municipal Annuities Administration
- Revenue bonds department, Municipal Annuities Administration
- Public Spaces fees department, Municipal Annuities Administration
- Advertisements and other trade fees and tax disputes department, Municipal Annuities Administration
- Sewage and Road Construction Fines Department, Municipal Annuities Administration
- Applied Informatics Department, Information Technology and Corporate Design Administration
- Information Systems Management Department, Information Technology and Corporate Design Administration
- Operations Planning Department, Municipal Police Administration
- Administration Management Department, Municipal Police Administration
- On-street controlled parking department, Municipal Police Administration
- Municipal Police Downtown Department, Municipal Police Administration
- Municipal Police 2-7 (0) Department, Municipal Police Administration
- Municipal Police 4-5-6 Department, Municipal Police Administration
- Administration of Finance Income Department
- Sewage and Road Construction Administration Licensing Department
- Cleansing, Recycling and Machinery Maintenance Administration, Street Cleaning Services Department

B. Team biographies

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Angela Borrachero Mendibil is a Client Account Leader and Manager at IBM in Spain. She manages a multidisciplinary team at an international level, capable of providing solutions to a global energy and utilities group of companies in a diverse and evolving context. Her interests are around renewable energy sources and the emergence of new technologies that make it possible for consumers to change their behavioural patterns and contribute to a more sustainable world.

Mendibil joined IBM in 1990 as a Tax Advisor after two years of law practice at a private law firm. From 1995 to 2007, she worked within the IBM Law Department, handling multiple law areas at local and global levels. She was the European Counsel of the Network Centric Operations Solution and the European Leadership Lawyer for the Safety and Security Centre of Competence, also becoming Counsel and Area Leader for Israel, Greece, Cyprus and Turkey. She has extensive experience as a transactional lawyer in the services arena, particularly in complex local and international deals. From 2008 to 2010 she worked as part of the European Headquarters, dealing with strategic consulting, including business plan and sales strategy, focused on services excellence processes.

Mendibil received an LLM degree in corporate tax law at IE Law School and a Bachelor degree in law from Universidad Autónoma de Madrid. In her free time, she enjoys spending time with her two sons, reading, listening to music and playing piano.

Dean Phillips is an Executive Architect and Global Client Technical Leader at one of IBM's largest automotive clients. He leads strategic projects in the areas of cloud, mobile, analytics and cognitive computing. His interests are in connected vehicle technologies, specifically streaming data analytics, in-vehicle information security and highly accurate mapping and geospatial technologies that enable assisted and autonomous driving systems. Phillips joined IBM in 1996 working on e-business projects and very quickly developed a specialty in automotive information systems.

Prior to his current assignment, Phillips led a worldwide team of experts focused on software architectures to enable effective system integration. His team led the deployment of a new product designed for the Internet of Things and connected vehicle messaging. Currently, Phillips is leading a set of mobility experiments in the areas of on-demand car rental, dynamic social ride sharing, intelligent parking and profile-based car insurance. Phillips received an Outstanding Technical Achievement Award for developing a working demonstration of a social, safe driving application built on the IBM Bluemix® cloud, Internet of Things foundation and IBM Watson™ technology.

Phillips received a BA from Wake Forest University, with foreign study at La Universidad de Salamanca, Spain, and an MS in international affairs from Florida State University. He has completed advanced studies with the IBM Executive MBA programs at Harvard University and Boston University.

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Piyush Malik leads the Worldwide Big Data Analytics Center of Excellence within the IBM Global Business Analytics and Strategy (BA&S) consulting practice, focusing on data-driven business transformation and data science. He has recently been inducted to IBM Academy of Technology, a select group of IBM-wide top technical experts. Previously he was the founding Director of the BAO Center of competency within IBM. With more than 25 years of management consulting background serving clients across geographies spanning four continents and several industries, he now focuses on strategic initiatives as CTO of Emerging Technologies for North America cross-sector BA&S service line.

Based out of the Silicon Valley in California, USA, for the past two decades, Malik joined IBM in 2002 via the acquisition of the PricewaterhouseCoopers management consulting business, where he led the Information Integrity practice, serving clients globally.

Malik received an undergraduate degree in electronics and communications engineering and a Masters degree in management of technology from the Indian Institute of Technology, Delhi. He serves on the boards of a number of professional and non-profit organisations.

Scott Neuman
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Scott Neuman is the Director of Marketing, Communications and Citizenship for the IBM Central and Eastern European region. This region covers 29 counties, including Russia, Poland, Czech Republic and Hungary. His responsibilities include all levels of marketing from traditional advertising to analyst relations to the next generation of digital and social marketing, spanning all business units within IBM.

Neuman's expertise lies in how emerging technologies (cloud, analytics, mobile and social) and traditional marketing goals intersect (discover, learn, try, buy, adopt and advocate). Over the past 15 years at IBM, Neuman has developed global and country-based marketing strategies, working with the leaders of many IBM business units, including Sales and Distribution, Software Group, Global Technology Services and Global Business Services. Most recently, Neuman led the development and evolution of the marketing and competitive strategy to shape the IBM Social Business story in the marketplace.

Neuman was a member of the IBM Corporate Services Corps deployed to South Africa in 2009 to provide free consulting services to local government organisations. He holds an MBA from Cornell's Johnson Graduate School of Management and a BS in communications from Cornell University. He and his wife Amy live in Prague, Czech Republic, with their three children.

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Todd Appel is a territory leader in the IBM Public Sector Solution Sales Team, focused on developing Smarter Planet initiatives in the areas of water, transportation, social services, public safety, counter-fraud and building management. He works with government and education clients to improve performance and increase citizen satisfaction, leveraging predictive analytics, decision support, collaboration and other IT-enabled solutions. He received a BA from UC Berkeley and an MA in international development from Columbia University, School of International and Public Affairs.

Appel joined IBM in 2002 as part of the acquisition of PricewaterhouseCoopers management consulting, where he worked with government clients in designing and managing large-scale transformation initiatives. Until recently, Appel served in a global role as an intelligent transportation expert, developing road user charging projects in Europe and the US. As a US national, he has spent a large part of his career living and working abroad, deepening his knowledge and appreciation of policy approaches and working practices in many countries. Currently, Appel lives in Colorado with his wife and three children, and in his free time enjoys bicycling, hiking and travelling.

Una Du Noyer has worked in information technology for more than 25 years. She has worked with clients across a number of sectors to define their IT strategy and how technology can transform their business in an ever-changing world. She has led teams of up to 400 technology consultants and architects and led large-scale IT transformation programs. Du Noyer has also worked in a number of interim roles, including Head of Global Infrastructure Strategy for a Fortune 100 organisation.

Her background is in infrastructure and networks, and she has been a spokesperson for both IBM and Capgemini on a number of topics, including new delivery models, such as cloud, environmental sustainability and service integration.

Du Noyer lives in London and is married with two sons. She has a degree in literature from King's College London, and reading remains one of her passions, along with spending time with her family and friends.

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E. Government driven by Open Data

Open Data is rooted in the principles of democracy and gives citizens the right to access data held by the government. It is not a new concept: freedom of information legislation to protect this right has been enacted in many countries around the world.

These laws enable citizens to request government-held information at little to no operational cost for producing this data.

Open Data is now seen as a foundational component of open government — a broader strategy that looks at the evolving roles of governments and citizens in delivering public services to society. Open government focuses on the following areas:
- Transparency and accountability
- Participation and citizen engagement
- Internal and external collaboration
- Innovation

The expectations are that by adopting open government principles, governments — in collaboration with business, non-profit organisations and engaged citizens — can deliver more services with higher quality and improved democracy.

Government 2.0 builds upon the open government concept with Internet technology, enabling new forms of communication and collaboration. The notion of Government as a Platform (www.mitpressjournals.org/doi/pdf/10.1162/INOV_a_00056) expands these principles even further by suggesting that governments provide a platform of public services upon which an ecosystem of value-added services and applications can innovate and grow.

Open source software and data

Data is having such an impact on business models and profitability these days that it is hard to find a non-trivial application that doesn't use data in a significant manner.

To get everyone on the same page, let's address a fundamental question, "What is open source?" Essentially, it is any software in which the source code (the underlying program) is available to anyone else to modify, distribute and so on. This means that, unlike typical proprietary development processes, it lends itself to collaborative development between larger groups, often spread out across large distances. From humble beginnings, the open source movement has developed to the point of providing operating systems (Linux), Internet browsers (Firefox), 3D-modelling software (Blender), monetary alternatives (Bitcoin) and even integrating automation systems for your home (OpenHab).

Open Data repositories are wonderful for many reasons, including the following:
1. Provide a source of insight and transparency into the domains and organisations that are represented by the data sets
2. Enable value creation across a variety of domains, using the data as the "fuel" for innovation, government transformation, new ideas and new businesses
3. Offer a rich variety of data sets for data scientists to sharpen their data mining, knowledge discovery and machine learning modelling skills
4. Allow many more eyes to look at the data, and thereby see things that might have been missed by the creators and original users of the data
5. Enable numerous "data for social good" activities (hackathons, citizen-focused innovations, public development efforts and more)

Some of the key players in efforts that use Open Data for social good include the following:

- DataKind, Bayes Impact, Booz Allen Hamilton, Kaggle, Data Analysts for Social Good, IBM and the Tableau Foundation. www.datasciencebowl.com/our-partners

- DataLook, "The Definitive Guide to Do Data Science for Good". blog.datalook.io/definitive-guide-data-science-good

The following seven Vs represent characteristics and challenges of Open Data:

- **Validity:** Data quality, proper documentation and data usefulness are always an imperative, but it is even more critical to pay attention to these data validity concerns when your organisation's data are exposed to scrutiny and inspection by others.

- **Value:** New ideas, new businesses and innovations can arise from the insights and trends that are found in Open Data, thereby creating new value both internal and external to the organisation.

- **Variety:** The number of data types, formats and schema are as varied as the number of organisations that collect data. Exposing this enormous variety to the world is a scary proposition for any data scientist.

- **Voice:** Your Open Data becomes the voice of your organisation to your stakeholders (including customers, clients, employees, sponsors and the public).

- **Vocabulary:** The semantics and schema (data models) that describe your data are more critical than ever when you provide the data for others to use. Search, discovery and proper reuse of data all require good metadata, descriptions and data modelling.

- **Vulnerability:** The frequency of data theft and hacking incidents has increased dramatically in recent years — and this is for data that are well protected. The likelihood that your data will be compromised is even greater when the data are released "into the wild". Open Data is therefore much more vulnerable to misuse, abuse, manipulation or alteration.

- **proVenance (with a "V" in the middle, but provenance is absolutely central to data curation and validity, especially for Open Data):** Maintaining a formal permanent record of the lineage of Open Data is essential for its proper use and understanding. Provenance includes ownership, origin, chain of custody, transformations that have been made to it, processing that has been applied to it (including which versions of processing software were used), the data's uses and their context, and more.

Here are some sources and meta-sources of Open Data:
- http://data.gov
- https://github.com/caesar0301/awesome-public-datasets
- www.census.gov/data.html
- www.healthdata.gov
- www.socrata.com/resources
- www.opendatanetwork.com
- www.quandl.com
- http://data.gov.uk
- http://open-data.europa.eu/en/data
- http://index.okfn.org/dataset
- http://ohiotreasurer.gov/transparency/Ohios-Online-Checkbook
- www.gapminder.org/data
- http://aws.amazon.com/datasets
- www.google.com/publicdata/directory
- http://datacatalog.worldbank.org
- www.kaggle.com/competitions
- www.kdnuggets.com/datasets/index.html
- www.crowdflower.com/data-for-everyone
- https://datafloq.com/public-data
- www.data-mania.com/blog/19-excellent-free-open-data-sources-for-doing-datascience

- www.datasciencecentral.com/profiles/blogs/great-github-list-of-public-data-sets
- www.datasciencecentral.com/group/data-science-apprenticeship/forum/topics/update-about-our-data-science-apprenticeship
- https://mran.revolutionanalytics.com/documents/data
- http://archive.ics.uci.edu/ml
- https://kdd.ics.uci.edu
- http://wiki.dbpedia.org
- http://blog.visual.ly/data-sources
- www.crowdanalytix.com/dataX
- http://blog.bigml.com/2013/02/28/data-data-data-thousands-of-public-data-sources
- http://people.stern.nyu.edu/adamodar/New_Home_Page/data.html
- www.smartdatacollective.com/bernardmarr/235366/big-data-20-free-big-data-sources-everyone-should-know
- www.sisense.com/blog/free-data-sources-upgrade-business-decision-making
- https://sites.google.com/site/braumoellerosu/ug-stats-resource-page
- http://readwrite.com/2008/04/09/where_to_find_open_data_on_the

To reference a city leveraging Open Data, there are many current examples. The Smarter Cities Challenge team for Helsinki did a full study on the use of Open Data to enhance city governance, which can be found here: http://smartercitieschallenge.org/city_helsinki_finland.html

Cities pioneering the use of Open Data

http://mashable.com/2011/02/15/how-open-data-initiatives-can-improve-city-life/#cc5.mliqoaq9
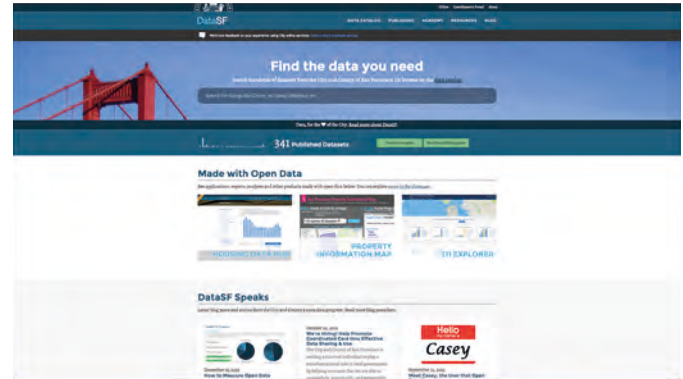
One of the common sources of data available to track trending sentiment is Twitter data. This data set is increasingly used in studying trends at any given moment and is often used in Open Data hackathons. Figure 30 shows an example use of a Twitter data feed the Smarter Cities Challenge team for Athens analysed using the Watson analytics tool to study the public sentiment around "Greek crisis".
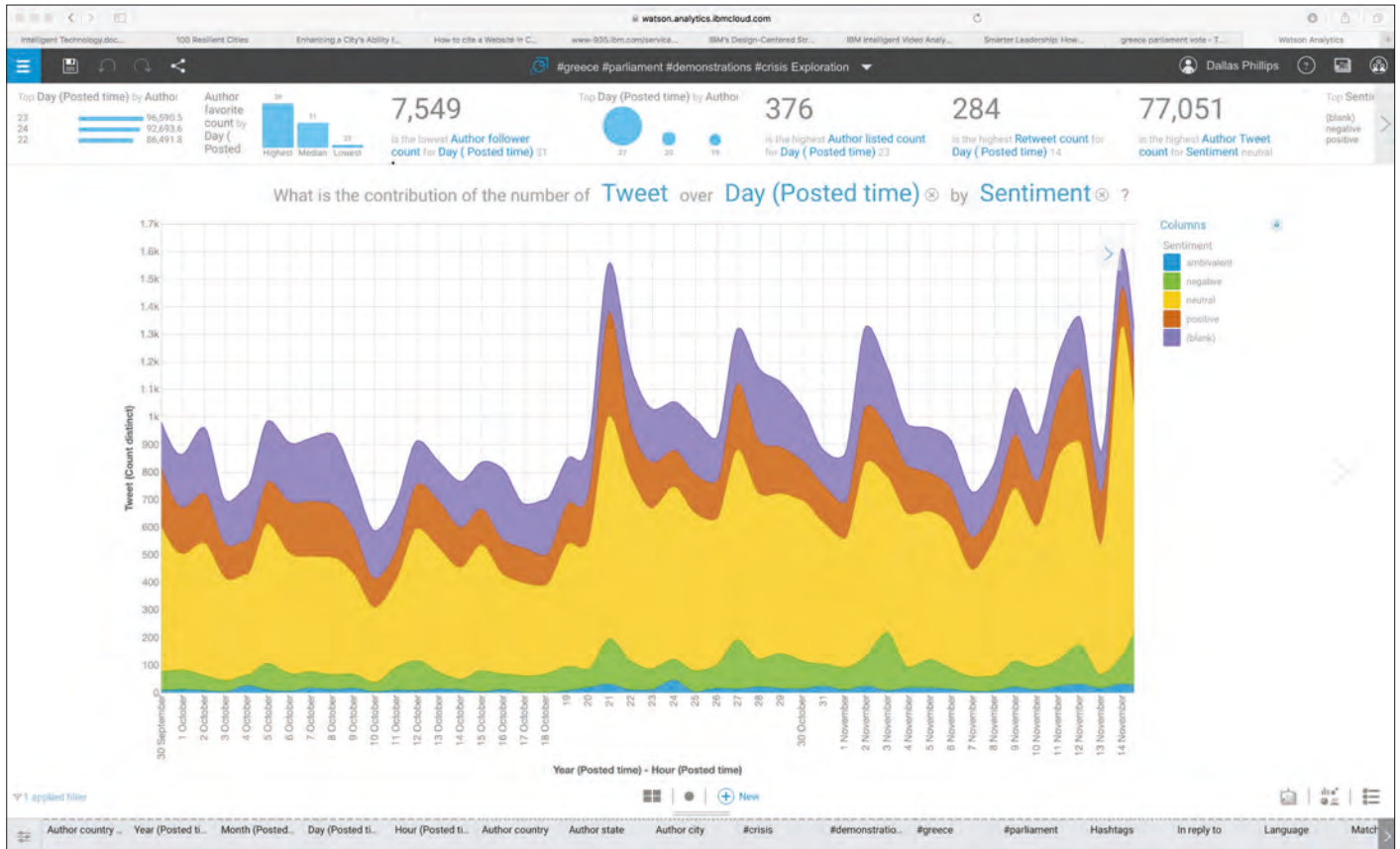
Figure 28: Illustrative example of using Twitter data for sentiment analysis — image outputs from Watson analytics data on November 19, 2015

F. Future opportunities

The report focuses on 12 main recommendations, with 29 different projects on a strategic roadmap aligning with the scope of the IBM team's study. Out of many discussions with stakeholders, here are a few more thoughts on future opportunities for Athens that are not related to transportation.

Optimise collection of waste with sensors

Waste piling up and spilling onto the pavements is a common sight in Athens. This could be reduced by the use of intelligent waste management systems. Waste disposal bins that are equipped with sensors and are connected to the Internet can inform garbage collection centres when they are full. The centre can then plan the most efficient route in line with the City's regulations based on zonal restrictions and collection-time windows.

Develop an environmental plan for the city centre

There are initiatives in Athens for environmental sustainability, and these could be extended into a comprehensive plan that could include the following initiatives:

- **Recycling:** Both residential and commercial. Apply ways to separate waste and position the different types for disposal. A municipal recycling plant also could provide options for alternate energy generation, as well as a revenue stream for the City.

- **Solar energy:** There are initiatives for incorporating solar panels on top of public buildings (primary schools, universities, municipal offices, for example) and sidewalks, as well as green spaces where appropriate (without obstructing views of monuments). This will directly support the EU 2020 Energy Strategy to reduce its greenhouse gas emissions by at least 20%, increase the share of renewable energy to at least 20% of consumption and achieve energy savings of 20% or more.

- **CO_2 emissions:** The Metro lines are a prime example of "green" transportation around the city. But more could be done. Currently, electric trolleys constitute less than 12% of the public transportation modes in service and less than 6% of the kilometres serviced. Increasing this would be a visible way to reduce both emissions and noise pollution. According to SATA, Athens, with 14,000 taxis, has 4 taxis for every 1,000 inhabitants, where the European average is 1 taxi for every 1,000 inhabitants. Having excess taxis constantly circling the city is a contributor to the emissions challenge, as well as traffic congestion. Another initiative for a future project is to increase the number of electric car charging stations across the Attica region. As of 2013, the penetration of plug-in hybrid vehicles (PHEV) was less than 0.05%, so this will need to increase before this initiative is ready to deploy. Overall, this is also supported by the EU "Environment Action Programme to 2020" with the goal of making EU cities more sustainable and to help address international environmental and climate challenges more effectively.

Optimise abandoned building usage in the historical and commercial centre

According to the report on the "Pilot Intervention into the Selected Area of the Commercial Triangle", there are 685 vacant floors in the historical and commercial centre of Athens. These include commercial and residential spaces at street level and above. The total increases to 746 if basement-level floors are included.

The next step is to break this out between private and public ownership, as well as study if the zoning regulations are causing the exodus of residents (through mixing residential with commercial use in the same building). But this represents an opportunity for the City to revisit the zoning regulations to encourage more businesses and residents to return to the centre of the city. This can include tax incentives, rent subsidies, student housing, conversion to public meeting spaces/cultural activities and development of start-up incubator facilities to name a few.

G. The "Journey of the Fine" workshop

Parking fines and other enforcement

The IBM team facilitated a workshop at the INNOVATHENS centre in Gazi, Athens. This was attended by almost 40 people, most of whom were from the Municipality of Athens and represented many different departments. These are listed at the end of this section. It was considered unprecedented to arrange for such a diverse group to meet for an information-sharing workshop, but it proved effective in surfacing the core issues of the collection of fines issued by the Municipality for a range of violations.

Many of the issues discussed reflected common themes that had been raised by previous interviews and had already helped inform the Smarter Cities Challenge roadmap. However, most of the previous discussions had focused on parking fines, and the value of the workshop was that it highlighted challenges in other areas of the fine issuance and collection process across the Municipality. These include fines issued to people for public space encroachment (cafes and restaurants that exceeded the number of tables allowed); waste management, cleaning and sanitation; and road construction.

There were also discussions regarding processes not directly relating to fines, such as the collection of municipal tax. There were common themes running through the challenges of the different departments, and the key themes are as follows:

1. The need to streamline the exchange of data with specific ministries. The parking fines process is dependent on retrieving name and address data related to vehicle number plates from the Ministry of Transportation and VAT data from the Ministry of Finance. Several other departments also need to retrieve VAT data (for example, fines relating to waste management and related to either company or personal VAT according to the violation). These departments have joined up to combine their requirements from the ministries and are confident through their discussions with the ministries that a solution to automate the request and the retrieval of data using APIs or other modern technical solutions will be developed.

2. The need to capture violations in real time. There is a need to capture data in real time because leaving a time gap allows people to correct the offence if they suspect they may be fined (for example, moving road constructions, kiosk constructions or cafe tables that are in violation of the regulations). It also can lead to an offence "timing out" before a fine is issued, such as a waste management violation. Several organisations suggested that having systems and applications that allowed for real-time data capture would be helpful, indicating that further use of hand-held devices, such as tablets to capture data on the spot, would be advantageous.

3. The need to make more processes digital and reduce reliance on paper-based systems. Several departments believed that further use of IT applications would help them become more efficient. Municipal tax collection could potentially be streamlined through adopting best practice applications from other cities. Issuing fines for public space encroachment, such as with cafe tables, can take a year and a half, and use of a tablet to issue fines on the spot, with digital access to relevant information, such as the establishment's license, would be very beneficial.

4. The obstacles to increasing enforcement in the centre. There were several views expressed, many of which had surfaced before, that the historical and commercial centre was subject to a high number of regulations due to its importance in terms of tourism, historical importance and commercial significance. This links with some views captured outside of this workshop — that the regulations are complex and not always clear, making it difficult for people to adhere to the rules. Other obstacles raised included the lack of a holistic view: that there were projects initiated that had synergies but were not joined up; bureaucracy; legal issues; and that the mindset of people needed to change, so they could accept that enforcement is necessary to improve the quality of life and commercial health of Athens.

Municipality departments represented at the workshop

1. Commerce and Development Administration, Food Businesses Penalty Notices Department
2. Municipal Annuities Administration
    a. On-street controlled parking fees and parking tickets payment Department
    b. Revenue bonds Department
    c. Public spaces fees Department
    d. Advertisements and other trade fees and tax disputes Department
    e. Sewage and road construction fines Department
3. Information Technology and Corporate Design Administration
    a. Applied Informatics Department
    b. Information Systems Management Department
4. Municipal Police Administration
    a. Operations Planning Department
    b. Administration Management Department
    c. On-Street Controlled Parking Department
    d. Municipal Police Downtown Department
    e. Municipal Police 2-7 (0) Department
    f. Municipal Police 4-5-6 Department
5. Administration of Finance Income Department
6. Sewage and Road Construction Administration Licensing Department
7. Cleansing, Recycling and Machinery Maintenance Administration, Street Cleaning Services Department
8. DAEM