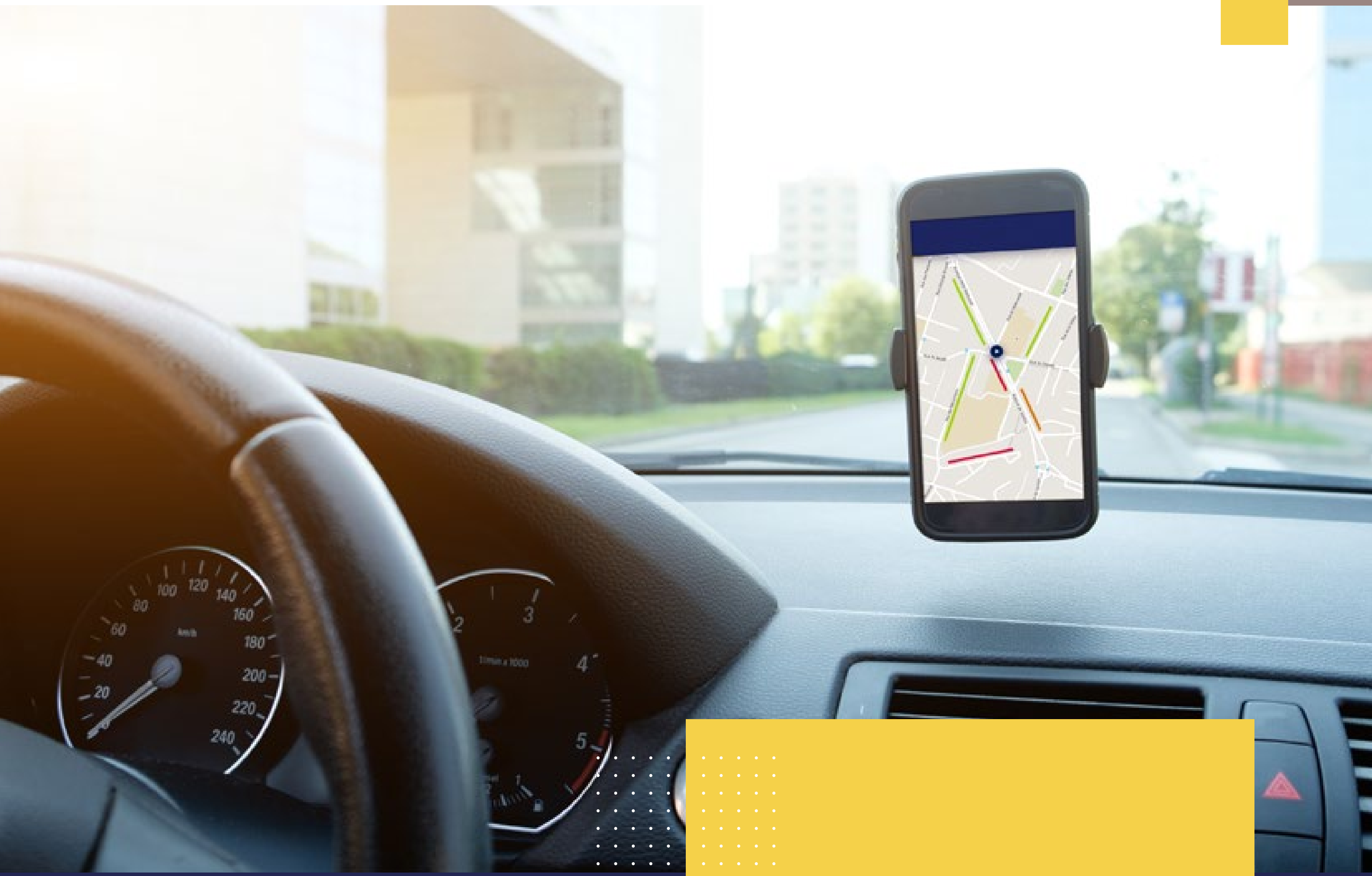
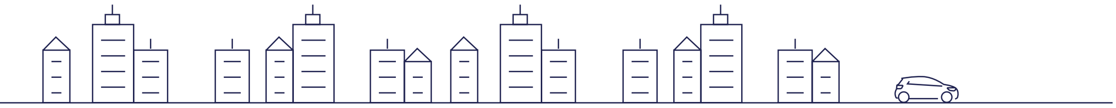
IEM

INNOVATIVE
PARKING
SOLUTIONS FOR
SMART CITIES



THE FUTURE OF SMART PARKING IS ALREADY HERE

WHITE PAPER · NOVEMBER 2017



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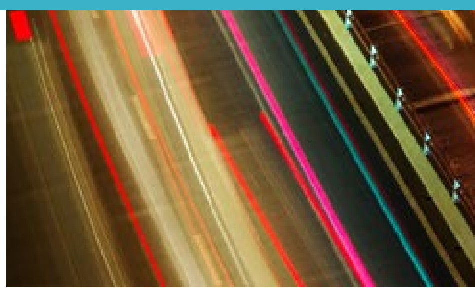
CONGESTED CITY CENTRES

CONGESTED CITY CENTRES

With traffic in urban areas constantly on the increase, city centre parking faces numerous, sometimes conflicting, challenges:

- → improve access to local businesses to encourage people to use them rather than out-of-town retail parks,
- → encourage people who work in the city centre to use park-and-ride schemes,
- → make the city centre more attractive for residents.
- → promote non-motorized traffic.

WHILE THE NUMBER OF VEHICLES IN TOWNS AND CITIES IS CONSTANTLY INCREASING, THE NUMBER OF PARKING SPACES REMAINS RESTRICTED BY LACK OF AVAILABLE SPACE.



In the 1960s, local authorities started to introduce parking rules to encourage vehicle turnover. Parking times were restricted and enforceable by fines to encourage motorists to free up their space, enabling more people to access the city centre. Then came the introduction of paid parking with the installation of parking meters.

Today, the imbalance between the supply of parking and demand from users is making city centres difficult to access. Motorists circling round in search of a space add to the existing traffic which in turn increases CO_2 emissions and congestion. **Paid, time-limited parking is no longer an adequate solution.**

SMART PARKING MANAGEMENT INVOLVES USING INNOVATIVE TECHNOLOGIES TO RELIEVE TRAFFIC CONGESTION IN THE CITY CENTRE.

A FEW FIGURES

10 minutes to find a space = 1,3 kg of CO_2[2]

1 hour of parking in 2 is actually paid for[1]

30% of traffic is generated by motorists looking for a space[2]

[1] Study conducted by the Canton of Geneva in Switzerland
[2] Study by APCOA Parking in Germany

OFF-STREET VS ON-STREET PARKING

OFF-STREET PARKING
refers to underground and other car parks with access controlled by entry and exit barriers. They are more accessible but more expensive to use. The cost of investment is between €35,000 and €50,000 per space, plus operating costs.

ON-STREET PARKING
refers to parking spaces on the street. It is mainly paid for via meters, subscription or smartphone but is sometimes free for a limited time by displaying a parking disc. Despite the large number of spaces, on-street parking is currently inadequate but needs to be optimised as an on-street parking space costs less than €1,000 a year.

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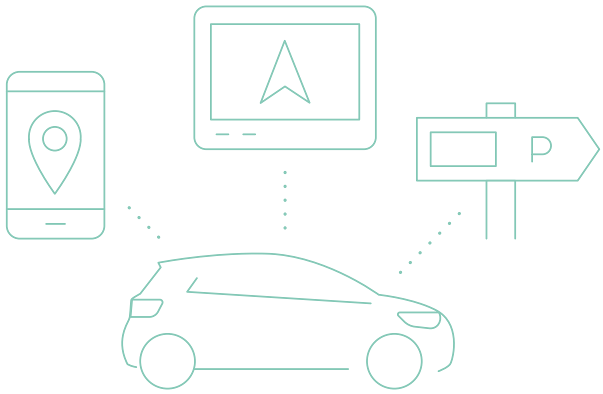


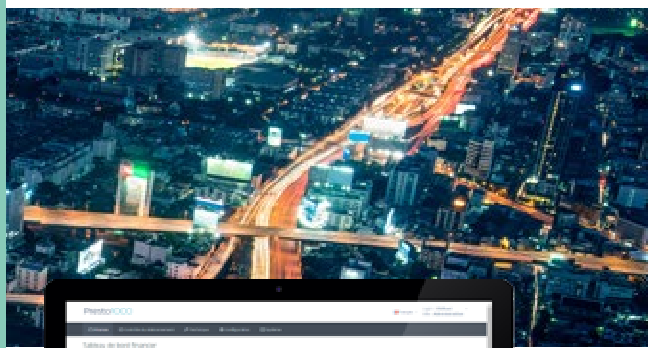
NEW TECHNOLOGIES FOR ON-STREET PARKING

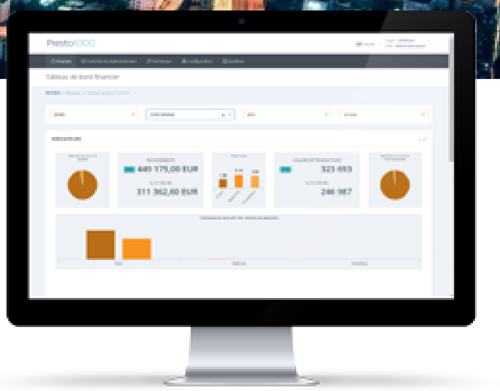
The new technologies used **gather thousands of items of data in real time** which relates to parking and, more specifically, the use of parking by motorists. This information is analysed, provided to the various stakeholders (motorists and management authorities) and cross-referenced with other similar data such as parking tickets.

This approach offers 4 new use cases for improving understanding of the current parking system and improving its efficiency in order to **enhance quality of life for residents and visitors.**

USE CASE N°1

ON-STREET PARKING MONITORING





Before they can optimise the current parking management system, councils need to understand it. To do this, they use indicators such as turnover rate, occupancy rate, average parking time and payment compliance rate.

This data is currently collected manually every 2 or 3 years in certain time periods and areas.

Although this methodology can provide a general analysis of changes in parking behaviour, the low frequency at which data is collected makes the decision-making process and therefore regulatory changes very slow.

By collecting occupancy data in real time, the council can **continuously study parking behaviour** and gain a better understanding of it. « What if? » - type predictive analyses (« what if we increase the charge by xx pence?») can thus be made based on this data.

PARKING INDICATORS

TURNOVER RATE
Average number of vehicles using the same space over a specific period.

AVERAGE PARKING TIME
Average time each vehicle spends in a paid parking space.

OCCUPANCY RATE
Ratio between the number of parked vehicles and capacity.

PAYMENT COMPLIANCE RATE
Ratio between the number of vehicles parked legally and the number of vehicles parked in paid spaces.

USE CASE N°2

UNOCCUPIED SPACE AVAILABILITY INFORMATION PROVIDED TO USERS

The real-time display of the number of unoccupied spaces on town information boards is very useful for motorists looking for somewhere to park. It enables them to **reduce the time looking for a space and optimise their journey.**

The system is in common use for off-street parking and is becoming a possibility for on-street parking. The occupancy rate in each street or area is dynamically displayed thus improving traffic flow.

This occupancy data can be displayed either on dynamic signs or directly on motorists' smartphones. As vehicles become more connected over the coming years, this information will be available directly on the dashboard.

WAYS OF COMMUNICATING INFORMATION FOR MOTORISTS

DYNAMIC SIGNS
Are located in the city centre or on incoming roads. These dynamic and illuminated signs provide a real-time display of the number of available spaces on paid public car parks and on the street by area.

SMARTPHONES
which are close to hand for many motorists, are a direct way of transmitting information relating to available on-street parking. Once an area is targeted, the user can be guided to its location. Even better is when they are built into vehicles with CarPlay and Android Auto systems. Parking-related apps are becoming increasingly user friendly for drivers.

IN-CAR GPS
is also an effective way of communicating information as it can easily use guidance options.

USE CASE N°3

ENFORCEMENT OPTIMISATION

The highest management cost in an on-street parking system is the cost of enforcement, which needs to be compared with income. It is also one of the main components of effective parking management. Indeed, **the more effective enforcement is, the more motorists comply with the parking policy**, which leads to a higher turnover rate and lower occupancy rate.

By cross-referencing occupancy information with payment data in real time, **the areas and time periods in which violations are more frequent can be identified**. In this way, the enforcement officer can work more efficiently, in turn increasing the payment compliance rate in the area concerned.

The EPA (European Parking Association) recommends « strictly enforcing on-street parking policies » in its "Urban parking policy guide »[3]. Meanwhile, the CERTU (French centre for the study of urban planning, transport and public facilities) states that blue-zone parking (for a limited time displaying a parking disc) « requires effective monitoring in order to work [4] ».

AUTOMATED MONITORING

VIRTUAL TICKET

The introduction of a virtual ticket, as opposed to a paper ticket, requires all registration plates to be monitored. Automatic identification enables the monitoring equipment to identify in real time whether adequate payment has been made.

DETECTION SENSORS

Vehicle-detection sensors record arrival and departure times to identify whether parking time limits are observed.

SCAN CARS

Scan cars are vehicles equipped with several cameras for reading the registration plates of vehicles parked in paid areas. These are compared with current parking authorisation data and then sent to enforcement officers.

USE CASE N°4

DYNAMIC PRICING

The cost of parking can be used to adjust the demand according to the supply. When the occupancy rate is known, **the parking price may be adjusted** accordingly.

Several pilots have been carried out, particularly in San-Francisco[5]. Results showed improvement in the use of spaces with the average price remaining unchanged or lowered throughout the city. Parking charges vary from one area to another. **Dynamic charging can be used to make it easier to find a space**, thus reducing traffic.

IMPLEMENTATION STAGES

HAVE RELIABLE EQUIPMENT
identifying the presence of vehicles in on-street parking spaces.

OFFER FLEXIBLE PAYMENT METHODS
in order to make frequent price changes. Parking meters and mobile apps are updated remotely.

INFORM USERS OF PRICE CHANGES
Motorists need to be informed beforehand using various communication methods.

STRENGTHEN ENFORCEMENT
to increase the payment compliance rate. Increased monitoring will lead to more responsive users.

ANALYSE THE RESULTS
to check the effectiveness of operations. Indicators will provide an insight into user behaviour and help with decision making to draw up an effective parking policy.

[3] http://www.europeanparking.eu/
[4] http://www.certu-catalogue.fr/
[5] http://sfpark.org/wp-content/uploads/2014/06/SFpark_Pilot_Project_Evaluation.pdf

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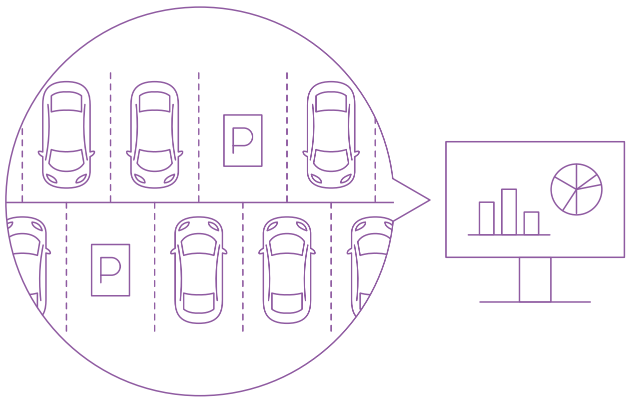

COLLECTING AND ANALYSING PARKING DATA

PREDICTION AND STATISTICAL MODELS

The « Lean Smart Parking » study conducted by Xerox with data from the San-Francisco pilot[6] showed that it is very difficult to use statistical models. We could intuitively think that data collected in one street or area could be extrapolated to others.

The study showed that this is not the case and even **between two neighbouring streets, completely different behaviour could be observed.**

This behaviour is affected by pricing, enforcement frequency, the presence of certain types of business, the time of day or even the day of the year.

The same also applies to systems which extrapolate the status of a road or area based on few observations. This is typically the case for smartphone apps which exploit data which only represents a small number of users. This data may not be representative of the behaviour of all motorists.

Similarly, the use of payment data only is not adequate for predicting the occupancy rate as payment compliance rates vary significantly according to location and time. This leads to predictions which are either too optimistic or pessimistic depending on whether the payment compliance rate is high or low.

THE USE OF PAYMENT DATA ONLY IS NOT ADEQUATE FOR PREDICTING THE OCCUPANCY RATE.

[6] https://www.xerox.com/downloads/services/white-paper/lean-smart-parking.pdf

EXISTING SOLUTIONS

All the use cases above are based on the real-time collection of accurate occupancy and payment information. Several technologies currently offer this information with varying levels of accuracy and cost. Several existing solutions are presented below.

VEHICLE DETECTION SENSORS

THE SIMPLE SENSOR

It is installed on each parking space and it is optimised to inform users of the occupancy status. It is not generally responsive or accurate enough to detect changes of vehicles so does not record the parking duration. It cannot be used to establish all the indicators or to optimise monitoring. Simple magnetic detection sensors are also disrupted considerably in urban areas by underground trains, trams and electric cars which generate significant magnetic fields.

THE HIGH-PRECISION SENSOR

It is similar to the simple sensor but combines several detection technologies and enhanced responsiveness. It can be used to establish all the indicators and to optimise monitoring. Like the simple sensor, it is relatively complex to install and its cost is linear according to the area to equip.

SURVEILLANCE CAMERAS

Camera-based systems are usually accurate and can be used to establish parking indicators and, in a limited way, optimise monitoring. However, problems arise when a large vehicle hides the spaces behind it or a vehicle is replaced by another similar vehicle of the same colour. They also lose accuracy in poor lighting (shady/overexposed areas) or at night when they struggle to detect a vehicle being replaced by one of the same colour.

SCANS CARS

A scan car is a car equipped with cameras which travels around the city centre streets scanning the registration plates of all parked cars. The benefit is that almost no equipment needs to be installed. However, the low frequency at which the scan car passes prevents all the indicators from being established or users from being informed in real time. It allows monitoring to be optimised on a sporadic basis.

PARKING METER TICKETS

Data from parking meter tickets is easy to use but depends on the payment compliance rate, which can be 30 to 50% in some European countries. This solution does not allow accurate indicators to be established or monitoring to be optimised. However, this data may be combined with data from other solutions in order to broaden its use.

MOBILE PAYMENT

Data from mobile payment apps faces the same problems as that from parking meter tickets. Its analysis is not very relevant in countries where only few people use them. Despite significant deployment planned for the coming years, this source of data will remain difficult to exploit due to the presence of several operators in the same town.

SUMMARY TABLE OF ON-STREET PARKING DATA SOURCES

TECHNOLOGY	ACCURACY	COST	REAL TIME	BENEFITS	DISADVANTAGES
Simple sensor	Medium	Medium	Good (<30s)	• Good level of efficiency for user information apps	• Does not enable all indicators to be established (turnover rate is impossible) • Does not enable monitoring to be optimised • Results may be affected by other magnetic fields (trams, underground, etc.) • Installed and monitored by the highways operator
High-precision sensor	High	High	Good (<30s)	• Detailed analysis and establishment of all the indicators • Enables monitoring to be optimised	• Installed and monitored by the highways operator
Camera	Medium	Medium	Good (<30s)	• Detailed analysis and establishment of indicators are possible	• Privacy protection issue • Environmental conditions need to be taken into consideration • Large vehicles can hide other vehicles
Scan car	Medium	Medium to low	Poor (>1d)	• Specific to optimising monitoring	• Impossible to establish indicators • Not financially viable for small towns
Parking meter ticket	Low	Low	Good (<30s)	• Data is already available, no installation required	• Limited to users who pay for parking
Mobile app	Low	Low	Good (<30s)	• Enables user behaviour to be monitored accurately	• Limited to users who pay for parking via mobile

INTERNET OF THINGS

The Internet of Things (IoT) is an extension of internet connectivity on objects, made possible by technological developments and lower costs.

The International Telecommunication Union has officially defined the IoT as a « global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies[7] » .

According to a study published by McKinsey, it is estimated that the number of connected devices in the world will increase by 15 to 20% a year to reach nearly 30 billion devices in 2020[8].

[7] ITU-T Y.2060
[8] http://www.mckinsey.com/industries/high-tech/our-insights/the-internet-of-things-sizing-up-the-opportunity

EQUIPMENT TO SUIT EACH REQUIREMENT

Cities implement parking policies appropriate to their size, population, economic activity and mobility offering. They have **different requirements** in terms of information for their own service or for their users.

Installing cutting-edge technological equipment which gathers enormous amounts of data each day is not necessarily required or viable for many councils. **A well-considered, appropriate choice** enables them to acquire the data required to optimise on-street parking management while limiting installation and operating costs.

ISSUE	INFORMATION REQUIRED	APPROPRIATE SOLUTION
Reduce traffic which is increased by vehicles looking for a parking space	Location of available spaces in real time	• Simple sensors • Cameras • High-precision sensors
Increase the payment compliance rate by strengthening enforcement	Location of vehicles in breach of the rules	• Scan car for immediate action • High-precision sensors for optimising enforcement officer rounds
Understand user behaviours	Real-time indicators: occupancy rate, turnover rate, average duration, payment compliance rate	• Parking tickets for an overview of parking activity • High-precision sensors for helping to make strategic decisions in specific areas and at specific times
Observe users' reactions to changes to parking rules	Establish indicators over a specific period with frequent data collection	• High-precision sensors

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