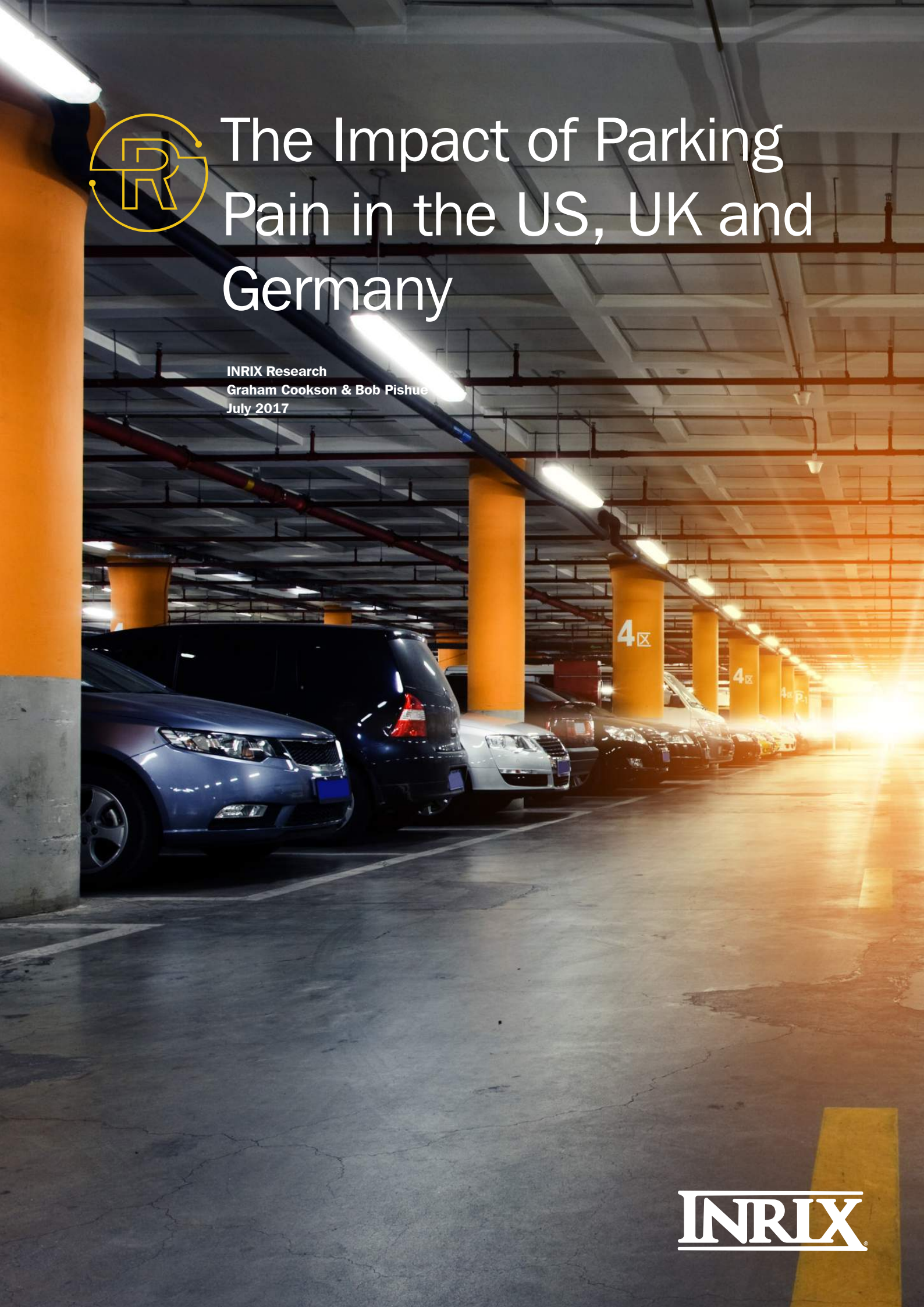

The Impact of Parking Pain in the US, UK and Germany

INRIX Research
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INRIX

ABOUT INRIX RESEARCH

Launched in 2016, INRIX Research uses proprietary INRIX big data and expertise to make the movement of people and goods more efficient, safer and convenient.

We achieve this by leveraging 500 Terabytes of INRIX data from 300 million different sources covering over five million miles of road, and combining it with our other data sources including global parking, origin and destination trip data, fuel, point of interest, public transport, and road weather information. Together, our data provide a rich and fertile picture of urban mobility that enable us to produce valuable and actionable insights for policy makers, transport professionals, automakers and drivers.

The INRIX Research team has researchers in Europe and North America and is comprised of economists, transportation policy specialists and data scientists with a mix of research backgrounds from academia, think tanks and commercial research and development groups. We have decades of experience in applying rigorous, cutting-edge methodologies to answer salient, real-world problems.

INRIX Research develops original, relevant and global research content to inform decision makers, transportation officials and the traveling public. In addition to our research outputs, INRIX Research is a valuable and free resource for journalists, researchers and policymakers. We assist with data, analysis and expert commentary on all aspects of urban mobility and smart cities. Spokespeople are available globally for interviews.

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1 EXECUTIVE SUMMARY

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1.1 INTRODUCTION

The impact of congestion on drivers and cities is well studied, including the annual INRIX Global Traffic Scorecard, which found drivers spent nine percent of their time sitting in traffic last year. The economic cost of this is also well known, with INRIX estimating traffic congestion cost U.S. drivers $1,400, U.K. drivers £968 and German drivers €1,531 each in 2016[1].

In comparison, parking is understudied, yet imposes a similarly significant burden on drivers and the wider economy. In fact, this study shows nearly one in three drivers abandoned their search for a parking space at least once in the past year, as drivers spend an average of nearly nine minutes in pursuit of a coveted spot.

The factors that predispose a city to congestion are the same as those that cause parking pain: large and growing populations, vibrant economies, relatively cheap motoring, and dense urban environments with limited land space. The parking problem is compounded due to the lack of information; many drivers simply don't know where space is available, increasing driver frustration and wasted time.

Just like congestion, parking pain is costly. For the individual driver, the search for parking results in wasted time and fuel, and incorrectly parking or running out of time can result in a parking fine. To the city, the search for parking clogs intersections and city streets, increasing traffic congestion.

The search for parking also worsens air quality, as vehicles emit greenhouse gases into the environment. In short, parking pain extends far beyond the driver's seat.

This is the first study that estimates the economic and non-economic impact of parking pain. The economic cost of parking pain in 30 cities in the U.S., U.K. and Germany is quantified and monetized in terms of: searching for parking, which results in wasted time, fuel and emissions, overpaying for parking, and parking fines. Several non-economic costs are also quantified, such as avoiding trips due to problems finding parking as well as increased frustration and stress. While paying for parking itself can be costly, this is excluded from the study as drivers can do little to avoid standard parking charges in most cities. Standard parking charges are a cost of driving like fuel and maintenance, but parking pain imposes an unnecessary economic burden in much the same way as traffic congestion does.

To undertake this study, INRIX Research leveraged the INRIX Parking database, the world's largest covering 100,000 locations across 8,700 cities in more than 100 countries, and combined this with a large-scale analysis of almost 18,000 drivers' parking behavior and experiences across the 30 cities. The results are staggering, with parking pain costing drivers in the U.S. $95.7 billion a year, drivers in the U.K. £31.2 billion and drivers in Germany €45.2 billion.

To reduce these costs, automakers, cities and businesses are relying more on providing drivers with real-time parking availability to ease parking pain. For example, the new BMW 5 Series displays on-street parking availability and new Mercedes Benz sedans include dynamic off-street parking, powered by INRIX Parking. A spot in a car park can even be reserved and paid for from within the vehicle.

Ultimately, while this research demonstrates that parking pain is a large burden for drivers, businesses and transportation planners in cities, solutions are available to help ease driver frustration and reduce the pains of parking.

1 *inrix.com/scorecard*

1.2
KEY FINDINGS

Combining the world's largest parking database with the largest ever study of drivers' parking behavior and experience, INRIX Research found that:

• Searching for parking imposes a significant economic burden with drivers in the U.S., U.K. and Germany wasting 17, 44 and 41 hours a year respectively at an estimated cost of $72.7 billion, £23.3 billion and €40.4 billion a year in these countries.

• Unsurprisingly, the largest cities and major financial centers suffer the most with drivers in New York (107 hours), London (67 hours) and Frankfurt (65 hours) spending the most time searching for parking each year.

• Paying for more parking time than required ("overpaying") is a universal parking pain with drivers in the U.S., U.K. and Germany (costing $20.4 billion, £6.7 billion and €4.4 billion a year respectively).

• Drivers in Germany get the highest number of parking fines a year on average (0.84 per person), followed by the U.K. (0.66) and the U.S. (0.20). Interestingly, German drivers paid the least in fines (€380 million), compared to drivers in the U.K. (£1.2 billion) and the U.S. ($2.6 billion).

• Together, these three components of parking pain cost a staggering $95.7 billion in the U.S., £31.2 billion in the U.K. and €45.2 billion in Germany.

• Parking pain also has non-economic impacts such as causing stress and leading to arguments with fellow drivers. For example, one-third (32 percent) of U.S. male drivers reported being in a confrontation with another driver over parking in the past year, while 69 percent of U.K. women reported feeling stressed by parking, and 40 percent of all drivers reported having missed an appointment due to problems finding parking.

• Parking pain has impacts on the wider economy. For example, more than 40 percent of all drivers said they avoided driving to shops in the past year, and almost one in three gave up on reaching their destination due to parking problems. Avoiding retail and leisure may have a significant impact on businesses and local economies as drivers turn to the internet or out of town offerings.

4

1.3
DATA AND METHODS

INRIX is a world leader in parking services for connected cars and transportation analytics. INRIX launched the industry's first[2] dynamic off-street parking service in 2013, followed by the first[3] integrated on-street parking solution in June 2015.

In August 2015 INRIX acquired[4] ParkMe, a leader in parking location, availability, and reservations worldwide. The company was recently recognized[5] by SBD for its comprehensive and accurate parking data in the U.S. and Europe.

INRIX is the preferred provider of parking information and services to leading automakers and application providers such as BMW, Lexus, Mercedes-Benz, Toyota, Microsoft and Waze, as well as transportation agencies and drivers around the world.

INRIX Parking includes the world's largest parking database with more than 35 million spaces in 100,000 locations spanning 8,700 cities in more than 100 countries. Dynamic occupancy information is also available for nearly 20,000 lots spanning 2,000 cities in 67 countries. Additionally, the INRIX On-Street Parking service leverages machine learning to deliver ground-truth tested dynamic occupancy predictions in nearly 40 cities worldwide.

For this research, INRIX supplemented its rich parking dataset with the largest ever study of drivers' parking behavior and experience, covering almost 18,000 drivers across 30 cities in the U.K., U.S. and Germany. Combining these two datasets enabled INRIX Research to calculate the economic cost of three measures of parking pain:

- Parking Search – The value of the time, fuel and carbon emissions spent in the search for parking for the average driver across a year.

- Parking Overpayment – The value of the extra, 'buffer' time drivers pay over what they needed to pay for parking across a year.

- Parking Tickets/Fines – The cost of parking fines received in a year.

By far the largest single cost is the search for that elusive parking space, therefore INRIX ranked each city within a country based upon the economic cost of parking search. Full details of the methodology and data sources are provided in the next section.

2. *http://inrix.com/press/2730/*

3. *http://inrix.com/press/drivers-can-find-parking-faster-with-new-inrix-on-street-parking-2/*

4. *http://inrix.com/press/parkme-english/*

5. *http://inrix.com/press/inrix-sbd-benchmark-parking-study/*

2 DATA AND METHODOLOGY

2.1 PARKING DATA

This study is the first of its kind, leveraging the world's largest parking database of 100,000 locations across 8,700 cities to offer genuine insight into the impact of parking on drivers in 30 cities across three major global economies.

Whether parking is on-street or off-street, the rate or price charged by parking operators usually varies by length of stay and the time and day of the week. Two parking rate variables were extracted from the INRIX Parking dataset:

INRIX Off-Street Rate – The average (mean) off-street rate for two-hours of parking on a typical Monday entering the parking lot at noon. Only public parking lots within one mile of the city center were included, and airport, railway, hotel, residential or venue parking lots were excluded along with any lots that offer minimum rates greater than two hours. Two hours was chosen because a significant number of lots globally have a two-hour minimum charge.

INRIX On-Street Rate – The rate for one-hour of on-street parking on a Monday at noon in the zone closest to, or incorporating the city center, excluding any convenience charges or discounts for using a specific payment mechanism (e.g. pay-by-phone services). Most on-street charging is linear so multiple minutes or hours are charged at a constant rate. In many cities, on-street parking is limited to two hours.

Table 1 presents a summary of the rate data extracted at city level in local currencies. The on-street rates have been multiplied by two to enable a clear comparison with the off-street rates. Generally, in most of the U.K. and all of Germany, on-street parking is more expensive than off-street parking. The exception is very short parking times (e.g. 15-30 minutes), which are typically cheaper due to the minimum time charged by most off-street parking operators (e.g. one or two hours). In the U.S. however, on-street parking is less expensive, except San Francisco.

Table 1: INRIX Parking Calculated Rates

CITY	TWO-HOURS ON-STREET	TWO-HOURS OFF-STREET
U.S. Cities		
Atlanta	$4.00	$6.30
Boston	$7.50	$25.59
Chicago	$13.00	$21.54
Dallas	$4.00	$6.46
Detroit	$4.00	$8.51
Los Angeles	$8.00	$13.87
New York City	$7.00	$32.80
San Francisco	$12.00	$11.81
Seattle	$9.00	$10.12
Washington D.C.	$4.60	$18.10
U.K. Cities		
Belfast	£2.40	£2.77
Birmingham	£7.00	£2.58
Bristol	£4.00	£3.67
Cardiff	£3.40	£5.59
Edinburgh	£7.60	£5.01
Glasgow	£6.00	£3.98
Leeds	£5.20	£4.83
London	£9.80	£12.53
Manchester	£6.00	£3.93
Southampton	£4.00	£1.73
German Cities		
Berlin	€6.00	€3.65
Bremen	€4.00	€2.53
Cologne	€6.00	€2.45
Dortmund	€3.00	€3.99
Dusseldorf	€5.80	€2.39
Essen	€4.00	€4.37
Frankfurt	€6.00	€4.15
Hamburg	€6.00	€4.75
Munich	€6.00	€5.66
Stuttgart	€7.00	€4.69

Generally, off-street parking rates reflect local market conditions and central locations in major cities of commercial, political or cultural significance. Similarly, local political and policy considerations generally dictate on-street parking rates with many cities favoring relatively high on-street rates to encourage high turnover and to support local business activity. As drivers can therefore do little to avoid these parking charges, this study focuses on other, indirect pains of parking including the cost of searching for parking, paying for additional unwanted parking time, and parking fines.

To complement the INRIX parking database, which focuses on parking rates, location and availability, INRIX commissioned the largest ever survey of drivers' parking behavior and experience. To generate a representative sample at city and country level, the study focused on 30 cities in three countries: U.S., U.K. and Germany. A total of 17,968 responses from adult (over 18) car owners were collected with an average of 599 per city. The largest cities had larger samples including London (1,737) and New York (1,105) as would be expected of cities of their size.

The sample collected is representative of the general driving population and the results are generalizable therefore.

The top 20 most popular car brands driven by respondents aggregated across all countries are illustrated in Figure 1. Toyota (12 percent) followed by Ford (11 percent), Chevrolet (10 percent) and Honda (nine percent) were most commonly driven by U.S. drivers. Ford (14 percent) is the most common brand among U.K. respondents followed by Vauxhall (nine percent), Audi (eight percent) and BMW (seven percent). In Germany, Volkswagen (14 percent), Audi (11 percent), BMW (10 percent) are significantly more common than Mercedes-Benz and Ford (both on six percent). Figure 2 shows a typical pattern of car group distribution, with the compact and economy sectors representing about 50 percent of the fleet driven by respondents.

Figures 3 and 4 illustrate that the sample is largely representative of the driving population, with an equal split between male and female respondents. The age profile is largely reflective of the underlying populations, but interestingly the U.S. sample has a greater proportion of younger drivers while the U.K. population favors slightly older respondents. This may reflect the relative size of cities in the two countries and their underlying populations.

Figure 1: Top 20 Car Brand Distribution

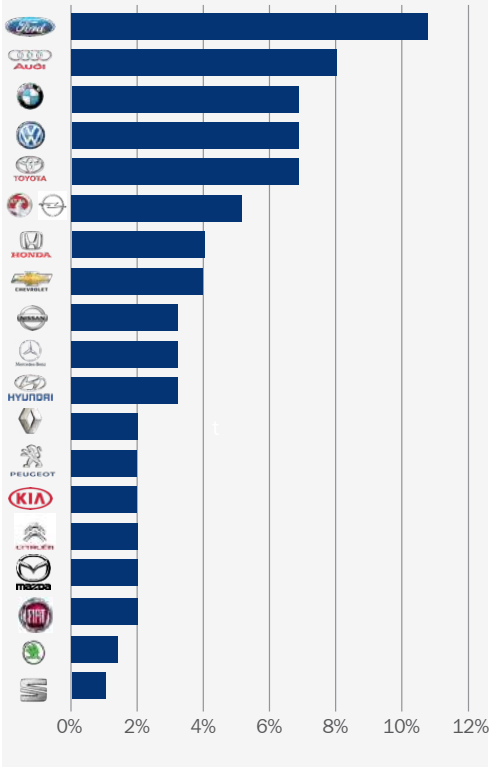


Figure 2: Car Group by Country

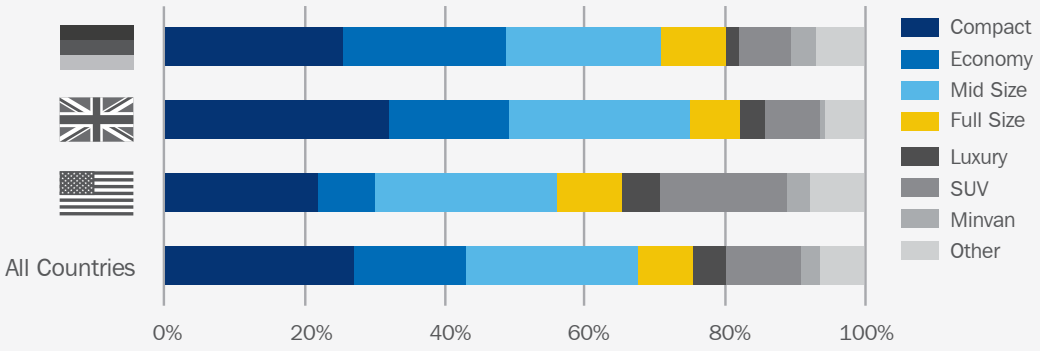
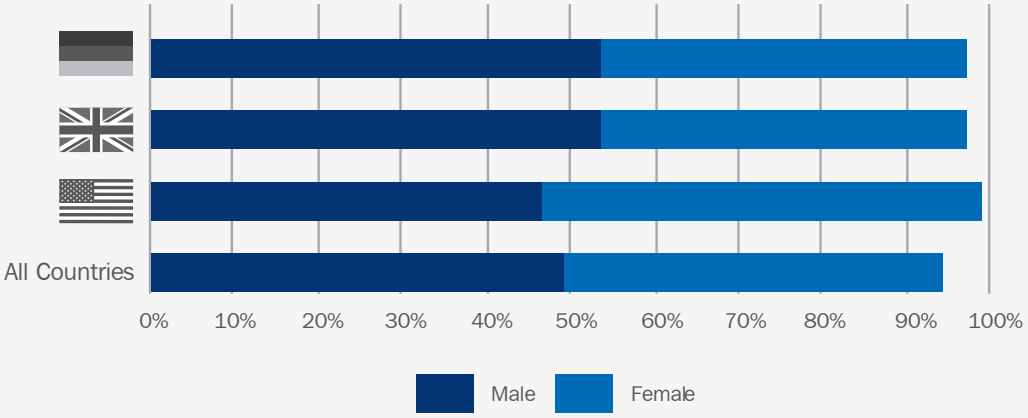
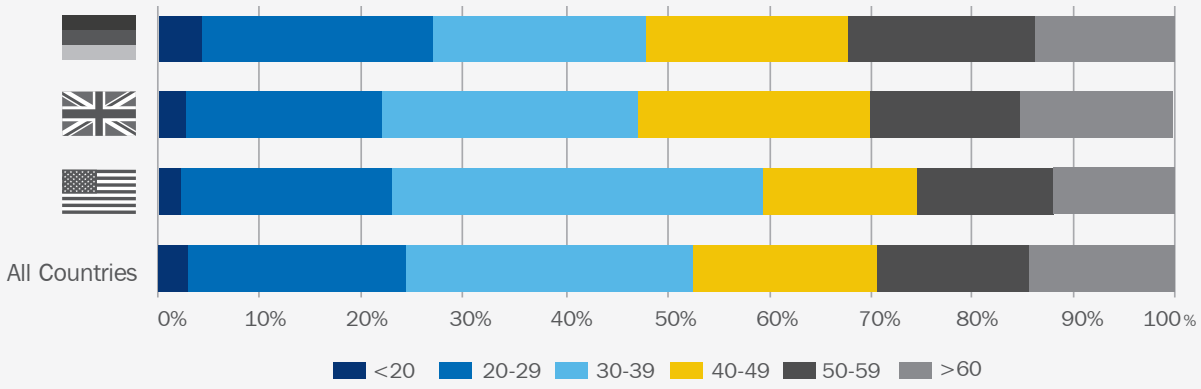


Figure 3: Gender Split by Country*



* Percentages may not sum to 100% where respondents did not specify their gender.

Figure 4: Age Profile by Country



2.2 METHODOLOGY

2.2.1 COST OF PARKING SEARCH TIME

The average time (in minutes per trip) that drivers in each city said it took them to find a parking space was named the "search time." This was also split by on-street and off-street parking. The weighted (by the proportion of parking that respondents reported parking on-street) average of on-street and off-street search time was multiplied by the average number of times per week respondents parked in each city, and then multiplied by 48 weeks per year. It was assumed that holidays alter the regular parking routine.

This study confirms the known fact that searching for parking is difficult and time-consuming, and highly likely to create additional externalities in the form of traffic congestion. To understand the burden that searching for parking places on households and the economy in terms that are readily understood, INRIX Research estimated the total economic cost of searching for parking in each city and country, using the economic methodology and values from the INRIX 2016 Global Traffic Scorecard[6].

Costs were calculated in local currencies using 2017 values and any source data were inflation-adjusted where appropriate, using a country specific measure of inflation taken from the World Bank. Direct costs are borne directly by the car driver through their search for parking, and include the value or opportunity cost of wasted time, plus the additional fuel cost and the social cost of emissions released by the vehicle.

The value of time depends upon the opportunity cost of that time i.e. what the person should have been doing. Business-related travel is more valuable than commuting time, which in turn is more valuable than leisure time. As the purpose of each trip is unknown, INRIX Research assumed that in all three countries 50 percent of car journeys are commuting, 10 percent for business and 40 percent for leisure. The value of time was adjusted by average car occupancy rates which again differ by purpose and country. Table 2 reports the estimate average value of search time per country.

Table 2: Value of Time Used for INRIX Parking Study

COUNTRY	VALUE OF TIME			CAR OCCUPANCY			AVERAGE VALUE OF TIME
	COMMUTING	BUSINESS TRAVEL	OTHER TRIPS	COMMUTING	BUSINESS TRAVEL	OTHER TRIPS	
U.S.	$12.81	$25.19	$9.51	1.13	1.94	1.94	$19.50
U.K.	£11.99	£17.91	£5.48	1.2	1.8	1.8	£14.36
Germany	€16.34	€24.40	€7.46	1.2	1.8	1.8	€19.57

To estimate the loss of fuel, this study uses an estimate of 0.4747 gallons of fuel consumed per hour in congestion[7]. Fuel is valued at the national average 2016 price of fuel, weighted toward the split of diesel and gasoline powered vehicles in the respective countries (U.S.: $2.53/gal[8]; U.K.: £4.13/gal[9]; Germany: €6.8/gal)[10]. The volume of emissions is also weighted toward the split of diesel and gasoline powered vehicles in their respective countries[11], and then valued at the inflation-adjusted, government recommended, non-traded value of carbon[12]. Table 3 presents the values used for each country.

Table 3: Values of Fuel and Carbon Used in INRIX Parking Study

COUNTRY	VALUE OF CARBON (PER KG)	FUEL PRICE (PER GALLON)
U.S.	$0.04	$2.53
U.K.	£0.06	£4.13
Germany	€0.07	€6.80

6. *http://inrix.com/scorecard/*

7. *Texas Transportation Institute, Urban Mobility Report (2012): https://mobility.tamu.edu/ums/archive/#umr2012*

8. *U.S. Energy Information Administration: http://www.eia.gov/petroleum/gasdiesel/*

9. *U.K. Department for Business, Energy and Industrial Strategy (2016):*

https://www.gov.uk/government/statistical-data-sets/oil-and-petroleum-products-monthly-statistics

10. *Statistica: https://de.statista.com/statistik/daten/studie/1690/umfrage/preis-fuer-einen-liter-superbenzin-monatsdurchschnittswerte/*

11. *https://www.gov.uk/government/statistics/digest-of-united-kingdom-energy-statistics-dukes-2016-main-chapters-and-annexes*

12. U.K Social Value of Carbon from HM Treasury:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483278/Valuation_of_energy_use_and_greenhouse_gas_emissions_for_appraisal.pdf, and U.K. values are used for Germany converted to Euros using World Bank Purchasing Power Parity exchange rates.

2.2.2 CALCULATING NATIONAL TOTAL AND AVERAGE COST

These economic values were applied to the average search time (in hours per year) to estimate the cost per driver per year in each of the 30 cities in the study. The 10 cities in each country were chosen because of their size.

As they are not representative of the entire country, the INRIX Global Traffic Scorecard was used to extrapolate the results of the analysis to the national level. The INRIX Global Traffic Scorecard provides estimates of congestion in over 1,000 cities across the world, and INRIX Research used the data to generate costs of traffic congestion in the U.S., U.K. and Germany. Given that many of the factors that make a city or urban area prone to levels of congestion are likely to also be factors that make parking in a city or urban area difficult, the INRIX Global Traffic Scorecard was an effective way to understand the national impact.

For example, in the U.S., the 10 cities included in this study accounted for 16.8 percent ($49.7 billion) of the total costs of congestion ($295 billion) identified in the INRIX Global Traffic Scorecard in 2016. If we assume that the same 10 cities will also generate approximately the same proportion of the U.S.' overall parking pain costs, this implies that the 'total' cost of parking pain in the U.S. is $72.7 billion.

Given the estimated total economic impact of parking in each country, the average driver cost can also be estimated by dividing the national cost by the number of cars or drivers in each country. For example, in the U.S., there are more than 210 million cars, implying an average driver cost of $345 per year.

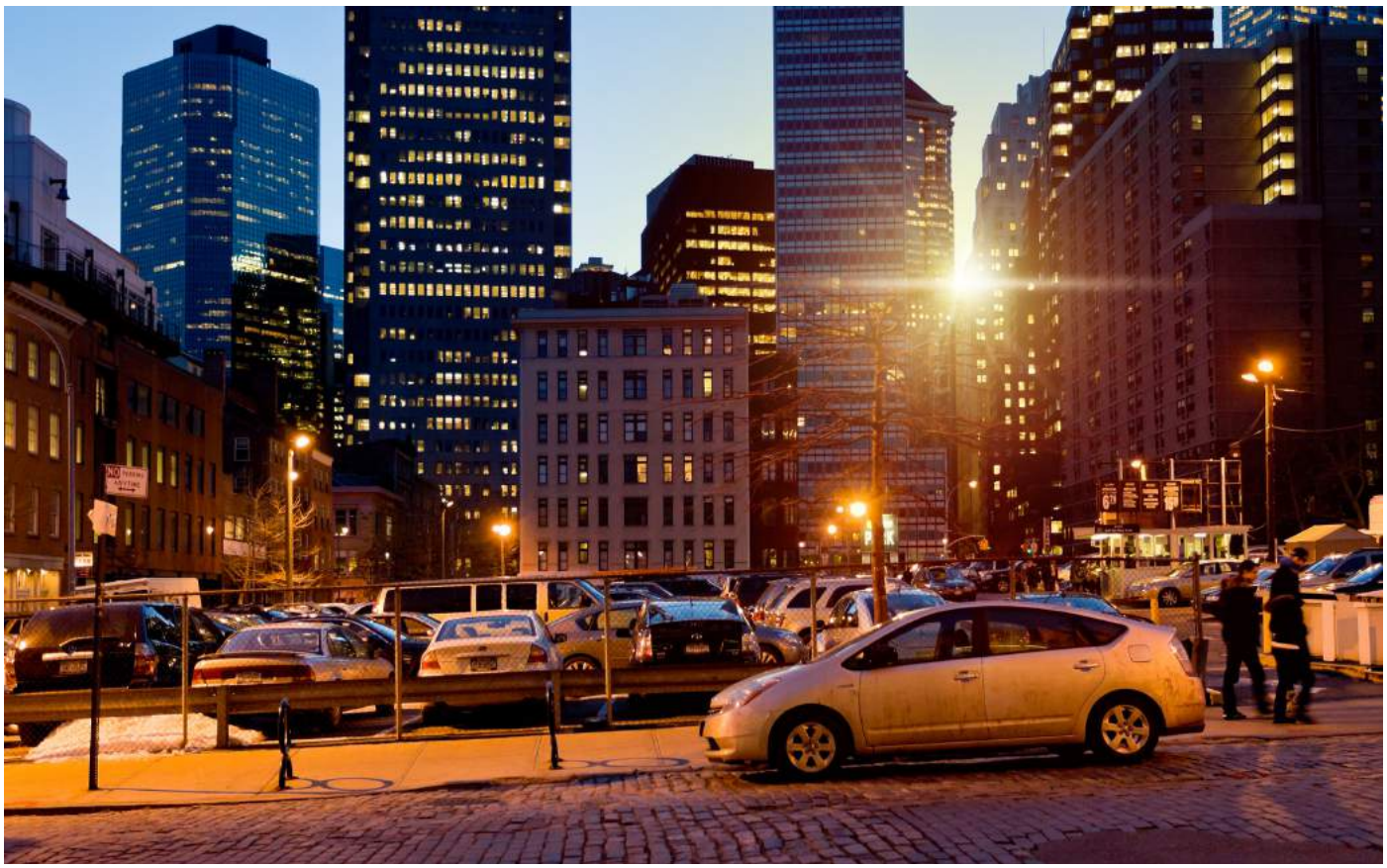
The same approach was taken when calculating the national total and national average (i.e. per driver) costs for overpaying and parking fines.

2.2.3 COST OF OVERPAYING FOR PARKING

The average amount of time (in minutes) that drivers overpaid for parking each time they park was named "overpaying." Overpaying is caused by drivers' inability to estimate precisely how long they need to park, rate-cards being set that force drivers to overpay (e.g. a two-hour rate when they need 30 minutes), or drivers' voluntarily overpaying to ensure that they don't get a parking ticket.

This value was multiplied by the average number of times per week respondents parked in each city and the proportion of these times that they reported paying for parking. Finally, this was multiplied by 48 weeks to recognize leave time and travel outside of the city, and divided by 60 (minutes) to convert it into hours per year.

The hours overpaid per year were split between on-street and off-street based upon the proportion of time drivers reported parking in each location and then they were multiplied by the appropriate hourly rate from the INRIX Parking database.



2.2.4 COST OF PARKING FINES

INRIX Research obtained the cost of a parking ticket from each city. Where a discount for prompt payment is offered it was assumed that everybody received the discount.

In the U.K., all parking offences are charged at one of two standard rates (£65 London and £35 rest of the U.K. after discount). In Germany, there is one Federal fee for parking offenses but the fee differs by offense. In the U.S., the penalty varies from city to city and offense to offense. In the U.S. and Germany, the appropriate local fine for an expired parking meter was used as the estimated parking fine cost. The average cost of a parking ticket in each city was multiplied by the average number of parking tickets received each year to calculate the cost of parking fines per driver.

3 ECONOMIC COST OF PARKING

3.1 COST OF PARKING SEARCH

In-car navigation was a major innovation preventing drivers from getting lost, while turn-by-turn navigation improved road safety and driver convenience. The addition of real-time traffic information allowed drivers to avoid traffic and road closures and optimize their journey, thereby minimizing delay. However, most drivers are still left with one key piece of the driving puzzle missing: parking.

When they arrive at their destination, especially in an unfamiliar area, they must hunt for a parking space. The search for parking results in lost time and fuel, increases traffic congestion and greenhouses gases released into the environment. A problem that technology can help fix.

The first step in quantifying the economic impact of the search for parking, is understanding the scale of the problem. The averaged results by city are provided in Table 4. Drivers in the survey spend nine minutes searching for parking. There is not much difference between the time spent searching for on-street compared to off-street parking, except in Germany where it takes 50 percent longer to find on-street parking. This search time is averaged across all parking situations away from the home and therefore represents a reasonable approximation of the real parking experience of drivers.

Drivers park on-street approximately 40 percent of the time with notable exceptions being New York (54 percent), San Francisco (52 percent), Boston (49 percent), Los Angeles (49 percent) and Berlin (48 percent). German drivers park most frequently at 10 trips per week, followed by American (nine) and British drivers (seven).

Table 4: Parking Search Time

CITY	ON-STREET SEARCH TIME (MINS PER TRIP)	OFF-STREET SEARCH TIME (MINS PER TRIP)	% ON-STREET PARKING	PARKING EVENTS (PER WEEK)
U.S. Cities				
Atlanta	8	8	37%	8
Boston	8	8	49%	8
Chicago	9	8	46%	8
Dallas	8	8	42%	8
Detroit	6	6	41%	7
Los Angeles	12	11	49%	9
New York City	15	13	54%	10
San Francisco	12	11	52%	9
Seattle	9	8	47%	9
Washington D.C.	10	9	47%	9
U.K. Cities				
Belfast	10	8	39%	8
Birmingham	8	7	37%	8
Bristol	9	8	42%	7
Cardiff	9	7	39%	7
Edinburgh	8	7	41%	7
Glasgow	9	7	39%	7
Leeds	8	7	38%	8
London	12	10	44%	8
Manchester	8	7	39%	7
Southampton	8	7	39%	6
German Cities				
Berlin	9	6	48%	10
Bremen	7	5	41%	10
Cologne	9	6	42%	10
Dortmund	8	6	43%	11
Dusseldorf	9	7	41%	10
Essen	8	7	44%	11
Frankfurt	10	7	42%	10
Hamburg	9	6	43%	9
Munich	9	6	44%	9
Stuttgart	8	5	41%	10

The four variables in Table 4 are used alongside the assumption that drivers keep to the same pattern of behavior for 48 weeks a year, to calculate the annual parking search time which is reported for each city in Tables 5-7. Annual hours spent searching for parking is converted to an economic cost using the methodology outlined in the previous chapter.

Table 5 presents the cost of parking search in the U.S., where on average drivers spend 17 hours a year searching for parking.

In the 10 U.S. and 20 European cities analyzed, New York had the highest parking search cost of $2,243 per driver per year, over six times the national average of $345. This is due to the annual hours spent searching for parking, at 107 hours in New York versus the 17 hours national average. The sizable gap is due to the U.S. being a large and diverse country with many drivers living in small towns or communities where parking is never a problem. Nationally, drivers in the U.S. waste $72.7 billion per year in time, fuel and emissions searching for parking.

Table 5: U.S. Parking Search Cost

INRIX PARKING RANK	CITY	ANNUAL SEARCH TIME (HOURS PER DRIVER PER YEAR)	PER DRIVER PER YEAR	TOTAL PER CITY PER YEAR
1	New York City	107	$2,243	$4.3bn
2	Los Angeles	85	$1,785	$3.7bn
3	San Francisco	83	$1,735	$655m
4	Washington D.C.	65	$1,367	$329m
5	Seattle	58	$1,205	$490m
6	Chicago	56	$1,174	$1.3bn
7	Boston	53	$1,111	$262m
8	Atlanta	50	$1,043	$251m
9	Dallas	48	$995	$726m
10	Detroit	35	$731	$209m
U.S.		**17**	**$345**	**$72.7BN**

The U.K. cost of searching for parking is reported in Table 6, where on average drivers spend 44 hours a year searching for a space, costing the U.K. £23.3 billion annually. The total city cost ranges from Southampton, at £98 million a year in wasted time, fuel and emissions, to London at £4.3 billion a year. Across all 30 cities in the study, London has the highest total cost because it is estimated to have the largest number of cars. Londoners spend over an hour a year in their search for parking, which is more than 50 percent above the national average. While Belfast ranks second regarding the per driver cost (£928 per annum) due to the 56 hours drivers spend searching for parking, the total citywide impact is more modest at £134 million a year as there are fewer cars. While Leeds, Bristol and Birmingham all have similar levels of wasted time searching for parking (47, 46, and 46 hours respectively), the total city cost is reflective of the size of Edinburgh, Glasgow and Manchester have some of the lowest parking search times of the 10 major U.K. cities included in the study but also some of the highest on-street parking rates.

Table 6: U.K. Parking Search Cost

INRIX PARKING RANK	CITY	ANNUAL SEARCH TIME (HOURS PER DRIVER PER YEAR)	PER DRIVER PER YEAR	TOTAL PER CITY PER YEAR
1	London	67	£1,104	£4.3bn
2	Belfast	56	£928	£134m
3	Leeds	47	£772	£297m
4	Bristol	46	£768	£169m
5	Brimingham	46	£757	£373m
6	Cardiff	44	£737	£126m
7	Manchester	41	£688	£169m
8	Glasgow	40	£660	£226m
9	Edinburgh	38	£625	£167m
10	Southampton	35	£588	£98m
U.K.		**44**	**£733**	**£23.3BN**

German drivers spend a national average of 41 hours searching for parking, as Table 7 presents, at a total cost of €40.4 billion to the German economy. This average is significantly lower than the 57 annual hours wasted by drivers across the 10 German cities analyzed. Frankfurt was the worst city for parking in Germany, with the highest annual search time and the highest per driver cost at 65 hours and €1,410 respectively. However, Berlin had the highest total city cost (€1.8 billion) due to a higher number of drivers in the city. Overall, the search for parking costs drivers in Germany more each than drivers in the U.S. and the U.K., at €896 per driver, or $1,140 2015 PPP.

Table 7: Germany Parking Search Cost

INRIX PARKING RANK	CITY	ANNUAL SEARCH TIME (HOURS PER DRIVER PER YEAR)	PER DRIVER PER YEAR	TOTAL PER CITY PER YEAR
1	Frankfurt	65	€1,410	€702m
2	Essen	64	€1,390	€490m
3	Berlin	62	€1,358	€1.8bn
4	Dusseldorf	61	€1,337	€564m
5	Cologne	60	€1,302	€861m
6	Dortmund	57	€1,239	€484m
7	Hamburg	52	€1,139	€1.5bn
8	Stuttgart	52	€1,136	€437m
9	Munich	50	€1,092	€1.1bn
10	Bremen	49	€1,065	€393m
GERMANY		**41**	**€896**	**€40.4BN**

3.2 PARKING OVERPAYMENT

Beyond the standard hourly or two-hour cost of parking, drivers often overpay to avoid a ticket, miscalculate the amount of time that is required or are stung by parking rates that are set longer than the required time (e.g. having to pay for two hours in an off-street lot even though the driver was parked for an hour and a half).

In an age of connected or smart technology where parking can be reserved and paid for by smartphone or even from within a vehicle, and where smartphone apps can monitor and inform drivers when parking time has elapsed, this should be a problem that can be easily resolved.

However, this study demonstrates that overpaying for parking is a real and large problem across all 30 cities studied. Drivers typically overpaid by 15 (Germany), 16 (U.S.) and even 17 (U.K.) minutes per trip. After weighting this to make it nationally representative and converting this to an annual value, Table 8 shows that drivers in the U.S. overpay by 13 hours per annum on average, compared to 45 and 42 in the U.K. and Germany respectively. At a city level, drivers in New York overpay the most out of all 30 cities analyzed (96 hours per year). Londoners (67 wasted hours) and drivers in Frankfurt, Essen and Stuttgart (all 71) lead their respective countries in overpayments.

INRIX Parking rate information was used to value this overpayment as described in Chapter 2. The cost of overpaying is substantial and while this doesn't represent an economic loss (as it is a transfer from driver to parking operator) it is a significant driver pain. Most drivers could find a more pleasurable use of this unnecessary expenditure. In the U.S., overpayments total $20.4 billion a year while in the U.K. and Germany they amount to £6.7 billion and €4.4 billion respectively.

Table 8: Extra Time Paid, in Hours and Value, Per Year.

RANK	CITY	OVERPAID TIME (HOURS P.A.)	OVERPAID COST (PER DRIVERS)	OVERPAID COST (PER CITY)
1	New York City	96	$896	$1.7bn
2	Los Angeles	70	$384	$796m
3	San Francisco	68	$404	$153m
4	Washington D.C.	59	$350	$84m
5	Seattle	46	$221	$90m
6	Boston	43	$362	$85m
7	Chicago	40	$353	$400m
8	Atlanta	35	$96	$23m
9	Dallas	30	$81	$59m
10	Detroit	22	$75	$21m
	U.S. AVERAGE	**13**	**$97**	**$20.4BN**
1	London	67	£380	£1.5bn
2	Belfast	61	£80	£12m
3	Birmingham	54	£113	£56m
4	Leeds	51	£127	£49m
5	Bristol	48	£92	£20m
6	Manchester	47	£110	£27m
7	Cardiff	44	£104	£18m
8	Southampton	42	£54	£9m
9	Edinburgh	37	£113	£30m
10	Glasgow	35	£82	£28m
	U.K. AVERAGE	**45**	**£209**	**£6.7BN**
1	Frankfurt	71	€174	€87m
2	Essen	71	€149	€53m
3	Stuttgart	71	€199	€77m
4	Dortmund	70	€124	€49m
5	Cologne	66	€129	€86m
6	Dusseldorf	65	€123	€52m
7	Bremen	59	€92	€34m
8	Munich	53	€155	€153m
9	Berlin	52	€124	€164m
10	Hamburg	45	€119	€155m
	GERMAN AVERAGE	**42**	**€98**	**€4.4BN**

3.3 COST OF PARKING FINES

Parking fines are typically imposed by a government for illegally parking a vehicle in a restricted or unauthorized spot, though private lot owners – depending on the city or country – may be able to levy fines as well. Parking fines, or tickets, are typically civil infractions or penalties that result in a monetary fine imposed on the owner or driver of the vehicle. The fines can vary by lot, city and country as well as the ability of the recipient to dispute or challenge the fine.

Data from the survey represents at best an approximation of the number of parking fines issued to drivers who live in each city. It is an approximation mainly because many fines will also be imposed on non-resident or commercial drivers who are excluded from the calculations. INRIX Research identified the approximate cost of a parking ticket in each city and country where applicable as outlined in Chapter 2, and applied this to the average number of parking fines drivers reported receiving in the past year. In all cases where a discount for prompt payment is available, INRIX assumed everybody received the discount – and applied local and federal fines when applicable. Table 9 displays the estimated parking tickets and respective per-driver fines by city and country averages.

The average driver in the U.K. pays more in parking tickets than the average driver in the U.S. and Germany. On the city-level, when adjusted for PPP, the typical London driver pays $105 in parking tickets per year, versus $85 in New York City. Parking fines in Germany are generally lower with little variation by location, unlike their U.S. and U.K. counterparts, yet Germans are ticketed more often on average than drivers in the U.S and U.K.

Table 9: Cost of Parking Fines

RANK	CITY	PARKING TICKETS (PER DRIVER PER YEAR)	PARKING TICKETS COST (PER DRIVER PER YEAR)	TOTAL PARKING TICKET COST (PER CITY PER YEAR)
1	New York City	1.31	$85	$164m
2	Los Angeles	1.05	$71	$148m
3	San Francisco	0.89	$64	$24m
4	Washington D.C.	0.81	$41	$9.8m
5	Boston	0.72	$18	$4m
6	Chicago	0.71	$35	$40m
7	Atlanta	0.58	$20	$5m
8	Dallas	0.54	$37	$27m
9	Seattle	0.45	$20	$8m
10	Detroit	0.35	$7	$2m
	U.S. AVERAGE	**0.20**	**$12**	**$2.6BN**
1	London	1.12	£72	£284m
2	Manchester	0.54	£19	£5m
3	Birmingham	0.48	£17	£8m
4	Glasgow	0.47	£16	£6m
5	Bristol	0.46	£16	£4m
6	Edinburgh	0.43	£15	£4m
7	Leeds	0.41	£14	£6m
8	Cardiff	0.41	£14	£2m
9	Southampton	0.35	£12	£2m
10	Belfast	0.32	£11	£2m
	U.K. AVERAGE	**0.66**	**£39**	**£1.2BN**
1	Stuttgart	1.5	€15	€6m
2	Frankfurt	1.39	€14	€7m
3	Cologne	1.31	€13	€9m
4	Berlin	1.29	€13	€17m
5	Dusseldorf	1.15	€12	€5m
6	Dortmund	1.11	€11	€4m
7	Essen	1.09	€11	€4m
8	Munich	1.04	€10	€10m
9	Bremen	1.01	€10	€4m
10	Hamburg	0.96	€10	€13m
	GERMAN AVERAGE	**0.84**	**€8**	**€380M**

3.4 ECONOMIC IMPACT ON BUSINESS

The relationship between parking and the economy is a complex but important one. Many local governments and policymakers set parking policies to encourage trade to local businesses and enterprises by ensuring that there is enough parking available in proximity to shops and other businesses. One way to do this is to encourage high turnover of parking spaces by imposing high parking rates and time limits, typically two hours.

To understand the impact of parking on local economies, INRIX Research asked drivers whether they avoided driving to shops, sporting events, hospitals or airports due to problems finding parking. While avoiding a trip may have diverted would-be drivers to other modes of transport, it may also indicate a willingness to cancel the trip altogether. With the rise of online shopping, for example, people may have opted instead to order from internet businesses rather than their local supermarket or shopping center.

Table 10 breaks out the survey responses by city. For example, nearly half of the drivers in London avoided driving to a shop in the past year due to parking problems, the highest percentage of any city surveyed. Drivers in New York were more likely to avoid driving to work than in other cities, as many people likely opt to use other modes of transportation (i.e. the subway) or telecommute in lieu of searching for parking.

In 29 of the 30 cities surveyed, over 50 percent of people reported avoiding driving somewhere due to issues finding parking, with a low of 43 percent of respondents in Detroit to a high of 76 percent of respondents in New York City.

Table 10: Avoiding Driving Due to Parking Problems by City

% OF DRIVERS WHO AVOIDED DRIVING TO THE FOLLOWING PLACES DUE TO PROBLEMS FINDING PARKING IN LAST 12 MONTHS						
CITY	SHOPS	WORK	AIRPORT	DOCTORS/ HOSPITAL	LEISURE/ SPORTS	AT LEAST ONE
U.S. Cities						
Atlanta	32%	15%	28%	18%	22%	57%
Boston	34%	14%	23%	18%	21%	59%
Chicago	32%	19%	26%	17%	22%	56%
Dallas	36%	13%	22%	16%	22%	54%
Detroit	27%	9%	14%	12%	18%	43%
Los Angeles	46%	30%	32%	24%	31%	71%
New York City	47%	32%	35%	23%	33%	76%
San Francisco	45%	27%	30%	24%	31%	72%
Seattle	37%	15%	26%	19%	28%	62%
Washington D.C.	40%	23%	29%	21%	24%	66%
U.K. Cities						
Belfast	36%	8%	12%	19%	9%	52%
Birmingham	36%	15%	19%	27%	12%	59%
Bristol	38%	13%	13%	24%	12%	57%
Cardiff	40%	12%	11%	24%	11%	57%
Edinburgh	42%	18%	24%	25%	12%	63%
Glasgow	35%	13%	21%	21%	9%	56%
Leeds	39%	11%	14%	26%	13%	57%
London	49%	27%	28%	30%	20%	74%
Manchester	33%	10%	18%	23%	12%	57%
Southampton	38%	8%	13%	22%	11%	53%
German Cities						
Berlin	39%	22%	27%	19%	16%	66%
Bremen	35%	18%	18%	19%	13%	58%
Cologne	43%	18%	23%	24%	20%	66%
Dortmund	41%	13%	18%	22%	16%	63%
Dusseldorf	43%	17%	26%	21%	17%	64%
Essen	34%	15%	20%	18%	12%	53%
Frankfurt	43%	16%	27%	24%	21%	69%
Hamburg	43%	16%	26%	21%	16%	64%
Munich	46%	20%	17%	21%	17%	64%
Stuttgart	40%	14%	25%	22%	18%	65%

3.5 NON-ECONOMIC COSTS OF PARKING PAIN

Not every cost of parking pain is easy to quantify or to convert into an economic cost. For example, across all 30 cities, 20 percent of drivers reported getting into an argument because parking over the past year (Table 11). The stress associated with parking is hard to quantify as well, with 64 percent of respondents from all 30 cities saying they felt stressed when searching for parking.

Higher stress levels can lead to higher medical costs and loss of well-being. Twenty-nine percent of respondents "gave up" on reaching their destination due to parking problems, leading to lost economic activity and possibly lower tax revenue collections. The driver frustration in such an eventuality can be immense.

In an era where an increasing amount of public and policymaker attention is directed towards non-market measures of performance such as happiness and mental wellbeing, these aspects of parking pain are important to raise if difficult to quantify objectively.

Table 11: Parking Frustrations

IN THE PAST YEAR, % OF DRIVERS WHO:	GERMANY	U.K.	U.S.	ALL COUNTRY AVERAGE
Were in an argument with another driver over parking	22%	16%	23%	20%
Felt stressed trying to find parking	66%	64%	61%	64%
Missed an appointment due to trouble parking	44%	38%	42%	41%
Gave up on reaching their destination due to problems finding parking	27%	26%	34%	29%

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People are known to break rules and societal norms, that's why INRIX wanted to gauge whether respondents in each of the 30 cities would be inclined to "cheat" even if they knew they would get away with it. In addition, we asked drivers in their respective cities what they thought were the worst parking sins: from parking in disabled or handicapped restricted spots, to double parking and leaving too much space.

Table 12 presents the percentage of drivers who currently try to stay one step ahead of the parking authorities and those who wish they could – and would – if they were guaranteed to get away with it. More than half of Germans have not paid for parking and got away with it in the past year, compared to less than one-third in the U.S. and U.K. Overall, roughly half of all respondents would not pay for parking if they thought they would not get caught.

In the U.S. and Germany, people were split on whether there was sufficient parking available, while in the U.K. the consensus was clear: 71 percent of people thought that there was not enough parking. And yet while this may be the expected response from drivers spending nine minutes searching for a space on every trip, the difference in opinion on this question is stark when the parking pain suffered across all cities and countries was very similar. Globally there are 3.5 to 8 parking spaces per car, and in the U.K. specifically parking space occupation levels can be as low as 50 percent[14].

The conclusion must be that there is not only a parking problem but a much greater parking information problem. One which technology can help fix.

Table 12: Parking Laws and Sins

	U.S.	U.K.	GERMANY	ALL COUNTRY AVERAGE
Received parking ticket in last 12 months (%)	32%	26%	49%	35%
Not paid for parking and got away with it (%)	31%	30%	56%	37%
Would skip paying for parking if could get away with it (%)	41%	47%	57%	48%
Not enough parking spaces are available (%)	49%	71%	53%	59%
Taking up 2 spaces is the worst parking sin (%)	49%	46%	43%	46%
Incorrect use of family or disabled parking is worst sin (%)	24%	26%	20%	24%

13. *Chester, M., Horvath, A., & Madanat, S. (2010). Parking infrastructure: energy, emissions, and automobile life-cycle environmental accounting Environmental Research Letters, 5 (3) DOI: 10.1088/1748-9326/5/3/0340011*

14. *http://www.britishparking.co.uk/write/documents/library/reports%20and%20research/bpa_uk_parking_sector_report_awweb.pdf*


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4 SOLUTIONS FOR PARKING PAIN

4.1 CONNECTED CAR SOLUTIONS

This study has demonstrated that parking pain is a universal problem that imposes significant economic and non-economic costs. Given the size of this multi-billion dollar problem, there is tremendous enthusiasm among drivers for solutions. INRIX asked nearly 18,000 drivers about their view on technology-related solutions to ease parking pain. The responses outlined in this chapter provide insight that will be valuable to the parking industry, automakers, cities and retailers.

Given the high economic cost of parking, INRIX asked drivers to rate parking pain relative to the other issues experienced on the road. Parking, it turns out, is second only to traffic congestion when it comes to driver-related problems (Table 13). Drilling down further, the cost of parking, uncertainty about finding a space and wasted search time are the top three parking frustrations (Table 14).

The good news is that many of these parking pains can be eased by technology. Smart parking solutions and connected cars and devices can be leveraged to reduce how long it takes to find parking, saving time and fuel. For example, INRIX Parking helps drivers find parking more efficiently than ever before based on cost, location and availability, and lets them reserve and pay for parking directly from their dashboard or mobile device. Automakers and app providers are starting to embrace smart parking solutions. For example, INRIX provides parking information and services to organizations such as BMW, Lexus, Mercedes-Benz, Toyota, Microsoft Bing and Waze, as well as transport agencies around the world.

Table 13: Biggest Driver Problem

	FINDING PARKING	CONGESTION AND DELAY	COST OF DRIVING	VEHICLE MAINTENANCE	ACCIDENTS	ROADWORK	BREAKING DOWN
U.S.	16%	21%	9%	7%	12%	10%	12%
U.K.	16%	18%	15%	7%	9%	12%	11%
Germany	16%	22%	10%	8%	14%	14%	14%

Table 14: Most Frustrating Aspect of Parking

	PARKING AVAILABILITY	WASTED SEARCH TIME	PARKING CLOSE TO YOUR DESTINATION	COST OF PARKING	STRESS RELATED TO PARKING	PARKING RAGE/ANTI SOCIAL BEHAVIOR
U.S.	15%	12%	12%	15%	10%	11%
U.K.	16%	9%	12%	19%	9%	12%
Germany	15%	12%	12%	15%	10%	11%

As Table 15 shows, the most desired features of smart parking solutions are real-time parking availability, finding and comparing the closest and cheapest parking, and being able to navigate directly to an available space. The ability to reserve parking through an app or service is also very popular, with 75-85 percent of respondents wanting to use this feature. Further, just under half of all respondents would like to use a mobile payment platform, either integrated into a vehicle or through a mobile app (Table 16).

Table 15: Most Desirable Features?

COMPARE CLOSEST AND CHEAPEST PARKING	ALREADY USE	WOULD LOVE TO USE	WOULD LIKE TO USE	WOULD NEVER USE
U.S.	7%	41%	41%	11%
U.K.	8%	34%	47%	12%
Germany	7%	38%	45%	10%
REAL-TIME PARKING AVAILABILITY	**ALREADY USE**	**WOULD LOVE TO USE**	**WOULD LIKE TO USE**	**WOULD NEVER USE**
U.S.	7%	45%	39%	9%
U.K.	6%	37%	47%	10%
Germany	7%	41%	45%	7%
ADVANCED PARKING RESERVATION	**ALREADY USE**	**WOULD LOVE TO USE**	**WOULD LIKE TO USE**	**WOULD NEVER USE**
U.S.	8%	37%	40%	15%
U.K.	8%	27%	44%	20%
Germany	7%	28%	42%	23%
ADVANCED PAYMENT	**ALREADY USE**	**WOULD LOVE TO USE**	**WOULD LIKE TO USE**	**WOULD NEVER USE**
U.S.	9%	30%	40%	21%
U.K.	9%	21%	41%	29%
Germany	7%	17%	35%	41%
NAVIGATION WITH PARKING	**ALREADY USE**	**WOULD LOVE TO USE**	**WOULD LIKE TO USE**	**WOULD NEVER USE**
U.S.	7%	43%	39%	10%
U.K.	6%	34%	46%	13%
Germany	9%	34%	46%	11%

There are some differences between the three countries analyzed in this study. Mobile payments are more popular in the U.S. than in the U.K. and Germany, with 56 percent of drivers preferring to pay through an app or their navigation system. This most likely reflects Americans' familiarity and experience with these platforms as their mobile payment usage is highest. Analysts expect this payment option to grow by 62 percent by 2021 in the U.S., accounting for $274 billion in payments[15].

15. Statista Digital Market Outlook, November 2016

Table 16: Parking Payment Preferences

	CASH AT A MACHINE	CARD AT A MACHINE	PAYMENT INTEGRATED INTO NAVIGATION	SEPARATE MOBILE APP
U.S.	15%	29%	28%	28%
U.K.	28%	27%	20%	25%
Germany	39%	22%	22%	17%
ALL COUNTRIES	**27%**	**26%**	**23%**	**24%**

The good news for drivers is that mobile parking payments is a reality. INRIX has partnered with the leading parking payment companies in the U.S. and Europe to let drivers reserve and pay for parking on-the-go from their vehicle or mobile device, regardless of provider. Partnerships with PaybyPhone, Parkmobile, SpotHero, Parking Panda and ParkU provides drivers with payment options in hundreds of cities across the U.S., U.K., Germany and France whenever they are using an INRIX-powered parking solution.

The recent INRIX Connected & Autonomous Vehicle Consumer Survey[16] showed that consumers want an integrated connected car experience where connectivity and content is delivered within the vehicle in an intuitive, safe way instead of via, for example, a mobile device. Approximately half of drivers want smart parking technology integrated into the car's navigation system with an additional 28 percent wanting it integrated into their preferred navigation app. Only a quarter of respondents favored a standalone parking app (Table 17). The research also demonstrated that consumers, in general, trust automakers more with their connected car data and privacy than other players, including major technology companies.

As this study has demonstrated, parking can be a painful and expensive problem. What can add to drivers' frustration is a complex, fragmented market, filled with varying restrictions, rate structures and payment methods. In an effort to make life easier on drivers, many automakers, for example, are committed to consolidating all of this information and embracing integrated, in-car parking solutions.

16. http://www2.inrix.com/research-cav

Table 17: Parking Technology Delivery Method

	IN NAVIGATION APP	IN STANDALONE APP	IN CAR'S NAVIGATION SYSTEM
U.S.	34%	23%	43%
U.K.	25%	27%	49%
Germany	27%	22%	52%
ALL COUNTRIES	**28%**	**24%**	**48%**

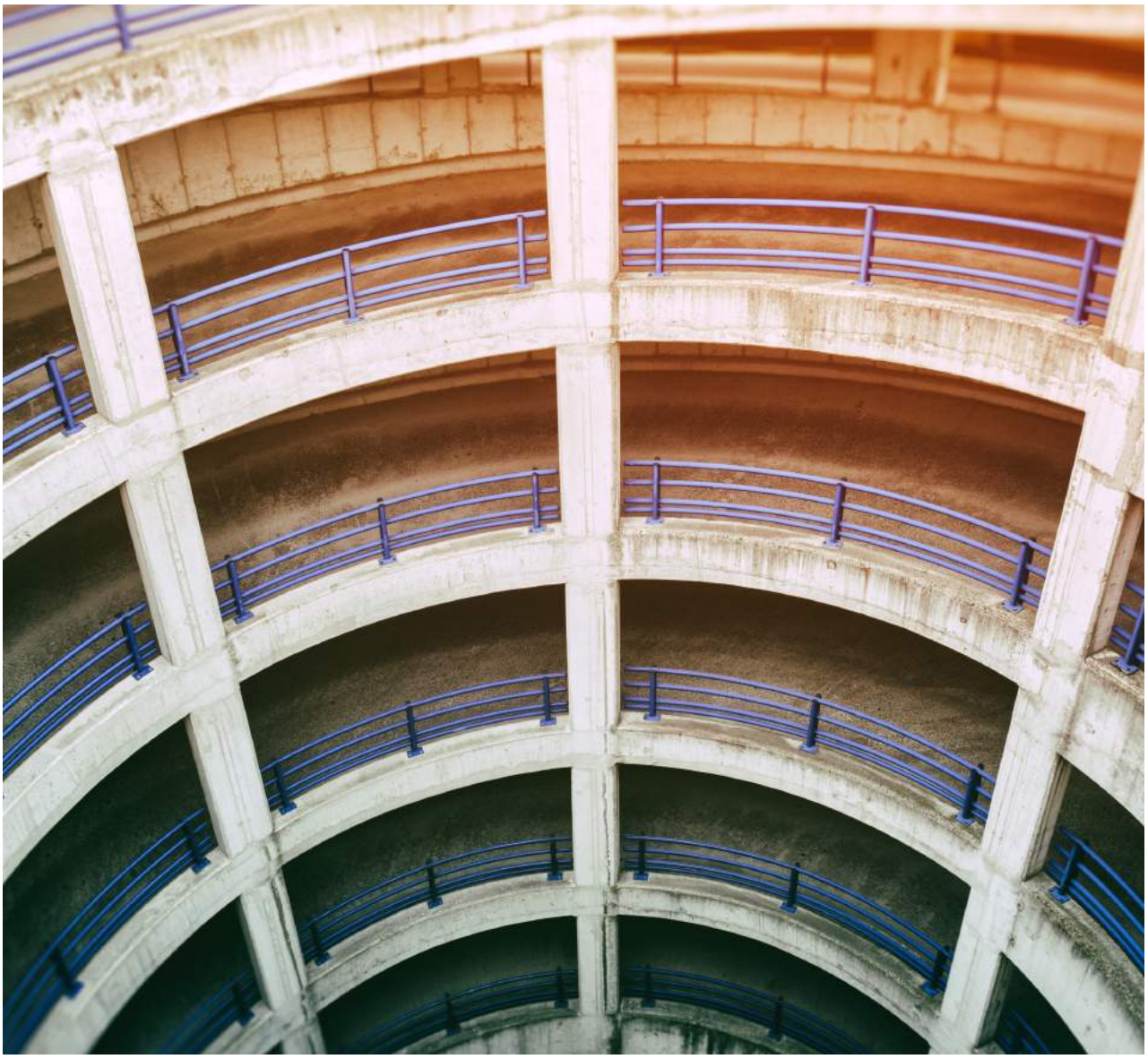
The 28 percent of drivers who prefer to use a navigation app for parking also have a solution. In September 2016, INRIX partnered with Waze to provide parking information to help Wazers around the world find and navigate to available lots near their destination.

Interestingly, Table 18 shows that 43 percent of all respondents do not want to pay for smart parking technology. This may reflect the fact navigation systems are generally becoming standard equipment and that technology has become a key battleground and product differentiator for automakers.

To date, most automakers are bundling parking solutions with other connected car services such as real-time traffic information and satellite or DAB radio. Most offer an initial free trial period (e.g. 3 or 6 months) at the time of sale followed by a monthly or yearly subscription plan. This approach allows drivers to experience the benefits of these services before committing to buying them. Additionally, the ongoing subscription model supports the continued improvement of services and coverage while spreading the cost across all owners of the vehicle.

Table 18: How Would You Like To Pay?

	ONE-TIME FEE	A SUBSCRIPTION SERVICE	FREE / WON'T PAY	PERCENT OF PARKING FEE	ADVERTISING
U.S.	27%	9%	40%	11%	14%
U.K.	27%	5%	46%	11%	12%
Germany	30%	4%	42%	10%	14%
ALL COUNTRIES	**28%**	**6%**	**43%**	**11%**	**13%**



4.2 SMART CITY SOLUTIONS

Solutions for parking pain differ between supply-side and demand-side strategies. Supply-side strategies include building infrastructure, whether constructing a new parking garage or installing Park-and-Ride access to transit in the suburbs. Demand-side strategies generally include variable pricing, encouraging more walking, biking and transit use, and levying parking taxes.

The policy in the U.K., for example, has focused on limiting additional parking in new developments in urban areas to cut down on automobile use. Yet new technologies exist to assist public officials and businesses to improve operations at a much lower cost than building new parking facilities.

For example, real-time parking applications and sensor-driven availability signs, allow drivers to get a clearer picture of what to expect when they park – allowing them to weigh the difference between price and convenience. Such remedies have been implemented across cities, business districts, malls and airports to provide drivers the most up-to-date and accurate information and improve the parking experience.

Cities that have adopted this approach to help reduce urban congestion in the U.S. include Austin, Las Vegas, Long Beach, Los Angeles, Miami Beach, Orlando, Dallas, Santa Monica and Walnut Creek. By collecting comprehensive parking data and turning it into real-time parking intelligence, INRIX is helping cities efficiently manage parking and create awareness for drivers. Furthermore, those responsible for parking in cities are empowered with tools to help them make data-driven decisions to curb congestion before it starts by guiding drivers to available parking.

This latest research offers good news for cities and infrastructure owners. Drivers' behavior could be modified *if* they had information on parking availability, which is possible with today's technology. To gauge how respondents would change their driving behavior based on parking availability, INRIX asked whether they would be more or less likely to drive if they knew that parking was or wasn't available (Tables 19 and 20). The results are remarkably consistent across the U.S., U.K. and Germany, as more than half of drivers were less likely to drive if they knew that parking was not available, while 71 percent of drivers were more likely to drive if they knew that parking was available.

Table 19: If You Knew That Parking Was Available How Would That Impact Your Decision To Drive?

	A LOT LESS LIKELY	LESS LIKELY	NO DIFFERENCE	MORE LIKELY	MUCH MORE LIKELY
U.S.	1%	1%	24%	35%	38%
U.K.	1%	1%	29%	38%	31%
Germany	1%	1%	27%	39%	32%
ALL COUNTRIES	**1%**	**1%**	**27%**	**37%**	**34%**

Table 20: If You Knew That Parking Was NOT Available How Would That Impact Your Decision to Drive?

	A LOT LESS LIKELY	LESS LIKELY	NO DIFFERENCE	MORE LIKELY	MUCH MORE LIKELY
U.S.	17%	31%	22%	16%	14%
U.K.	21%	37%	24%	11%	7%
Germany	19%	34%	27%	13%	8%
ALL COUNTRIES	**19%**	**34%**	**24%**	**13%**	**10%**

The partnership between INRIX and General Growth Properties (GGP) is an excellent case study of this in practice. GGP is an S&P-500 retail real estate company with 126 properties in 40 states in America with over 600,000 parking spaces. In a highly competitive industry, brick-and-mortar retailers are turning to technology to enhance the shopping experience, especially as parking is ranked among the top pain points for customers. The INRIX driver survey found that 40 percent of respondents avoided driving to shops in the past year due to parking issues. Seeing as parking availability is vital to the competitive landscape, INRIX developed a new tool using historical and real-time data to accurately predict parking availability at 97 GGP retail properties. The ability to reach millions of drivers by seamlessly integrating parking information into connected cars and mobile apps is leveling the playing field between e-commerce and the more traditional shopping experience.

Another way to reduce parking pain is to understand why drivers prefer one spot over another. To gauge this preference, INRIX asked respondents where they prefer to park if both on- and off-street options were available. Interestingly, the survey revealed (Table 21) a 2:1 preference for off-street parking lots or garages over on-street if both were available. This difference grows more pronounced in Europe, where both U.K. and German drivers prefer off-street parking more than on-street parking. This is important information for city planners and parking officials who struggle to determine the optimal use of road and curb space in dense urban areas. It's even more important in Europe, where streets are often narrower than streets in the U.S., limiting the ability to have parking on both sides of the road and free flowing traffic in-between. A significant gender difference exists in driver preference, as females prefer off-street parking more than males by as much as 10 percent.

Table 21: On-Street Vs. Off-Street Preference

	OFF-STREET	ON-STREET
U.S.		
Male	51%	49%
Female	64%	36%
U.S. Total	58%	42%
U.K.		
Male	65%	35%
Female	72%	28%
U.K. Total	68%	32%
Germany		
Male	74%	26%
Female	81%	19%
Germany Total	77%	23%
ALL COUNTRIES	**67%**	**33%**

The results also show females' preferences are influenced by ease and security, while men are more influenced by cost and proximity. However, both genders prefer ease and security over cost and proximity. Again, this offers interesting and valuable insights for parking, venue and mall operators who wish to serve various demographics.

Table 22: Why Would You Prefer To Park There?

	COST	EASE	PROXIMITY	SECURITY
U.S.				
Male	20%	20%	23%	38%
Female	14%	27%	16%	43%
U.S. Total	17%	24%	19%	41%
U.K.				
Male	15%	20%	21%	44%
Female	11%	22%	16%	51%
U.K. Total	13%	21%	18%	47%
Germany				
Male	9%	27%	19%	46%
Female	7%	32%	15%	46%
Germany Total	8%	29%	17%	46%
ALL COUNTRIES	**13%**	**24%**	**18%**	**45%**

5 SUMMARY

Parking is a pain, one which has significant impact on drivers, cities and the wider economy. This research is the first attempt to quantify the scale of the parking pain problem and to calculate its economic impact.

INRIX Research has supplemented its rich parking dataset with the largest ever study of drivers' parking behavior and experience, covering almost 18,000 drivers across 30 cities in the U.K., U.S. and Germany. INRIX Parking includes information for more than 35 million spaces in over 100,000 locations spanning 8,700 cities in more than 100 countries.

Combining these two datasets enabled INRIX Research to calculate the economic cost of three measures of parking pain:

- Parking Search – The value of the time, fuel and carbon emissions spent in the search for parking for the average driver across a year.
- Parking Overpayment – The value of the extra, 'buffer' time drivers pay over what they needed to pay for parking across a year.
- Parking Tickets/Fines – The cost of parking fines received in a year.

Table 23 summarizes the national average and total cost for each of three components of parking pain and calculates the overall parking pain cost. Together, these parking pain components amount to a staggering $95.7 billion, £31.2 billion and €45.2 billion in the U.S., U.K. and Germany respectively.

Table 23: Summary Statistics

PER DRIVER	PARKING SEARCH COST	OVERPAYMENT COST	PARKING TICKET COST	TOTAL COST
U.S.	$345	$97	$12	$454
U.K.	£733	£209	£39	£981
Germany	€896	€98	€8	€1,002

COUNTRY COST	PARKING SEARCH COST	OVERPAYMENT COST	PARKING TICKET COST	TOTAL COST
U.S.	$72.7bn	$20.4bn	$2.6bn	$95.7bn
U.K.	£23.3bn	£6.7bn	£1.2bn	£31.5bn
Germany	€40.4bn	€4.4bn	€380m	€45.1bn

By far the largest single cost is the search for that elusive parking space, representing 70-90 percent of the overall parking pain cost. Drivers spend an average of 17, 44 and 41 hours a year searching for parking in the U.S, U.K. and Germany respectively, costing all drivers in those countries an estimated $72.7 billion, £23.3 billion and €40.4 billion a year. Paying for more parking time than is required ("overpaying") is a universal parking pain with drivers in the U.S., U.K. and Germany wasting $20.4 billion, £6.7 billion and €4.4 billion per year. Drivers in Germany get the highest number of parking fines per year (0.84 per person), followed by the U.K. (0.66) and the U.S. (0.20), but relatively low fines in Germany compared to the U.K. and U.S. mean that total parking fines amount to €380 million, £1.2 billion and $2.6 billion respectively.

Drivers claim that parking pain is the second biggest driver problem after traffic congestion. Thankfully, technology can help alleviate the pains of parking with solutions that are extremely popular with drivers. For instance, over 90 percent of respondents want real-time parking availability, almost 90 percent want to be able to search for closest or cheapest parking, and nearly 90 percent again want to be able to navigate directly to their chosen parking space. Seamless integration is the key to pleasing consumers with over three-quarters of respondents wanting to use smart parking technology as an integration into their navigation platform, the vast majority of which want this to be the in-car dashboard. And encouragingly for automakers and technology providers, two-thirds (67 percent) of drivers are willing to pay for it.

The research also demonstrates that widescale adoption of this technology will have a significant impact on cities, parking providers and even retailers, as parking pain extends to the wider economy. For example, while more than 40 percent of drivers reported avoided driving to shops in the past year, 71 percent of drivers are more likely to drive if they know that parking is available. Making this information available in real-time is possible, as the case study of Global Growth Properties in Chapter 4 exhibits. Driver behavior is clearly affected by information, which is also good news for congestion prone cities. More than half of drivers claim that they are less likely to drive to their destination if they knew that parking wasn't available. Parking information is therefore the key to both demand management and parking space optimization.

This study has made one thing abundantly clear: parking pain is costing drivers and the economy significantly both in economic and non-economic terms. Yet parking space occupancy can be as low as 50 percent even in the most congested urban environments[17]. There isn't a parking problem as much as a parking information problem that technology can help solve.

17. http://www.britishparking.co.uk/write/documents/library/reports%20and%20research/bpa_uk_parking_sector_report_awweb.pdf

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