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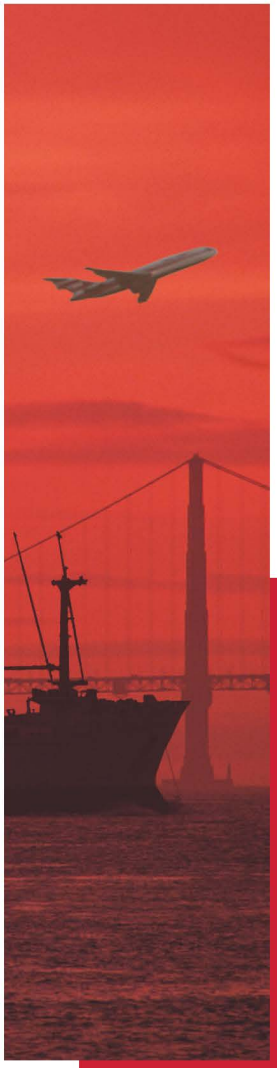

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Research for TRAN Committee - Odometer tampering: measures to prevent it

STUDY

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AUTHORS

TRT Trasporti e Territorio – Enrico Pastori, Raffaele Vergnani

Research managers: Beata Tuszyńska, Christina Ratcliff
Project and publication assistance: Adrienn Borka
Policy Department for Structural and Cohesion Policies, European Parliament

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To contact the Policy Department or to subscribe to updates on our work for the TRAN Committee please write to: Poldep-cohesion@ep.europa.eu

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Abstract

Odometer tampering is still a widespread malpractice in the European Union and it affects almost all second-hand car markets of its Member States. This study examines how improvement can be made by presenting the best practices implemented in some Member States and countries outside of the EU, while emphasising their success factors and results achieved. Furthermore, the study highlights the available technological developments and IT solutions to combat the phenomenon with a view to a potential further application by the European automotive industry.

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LIST OF ABBREVIATIONS

AA	Automobile Association
ACEA	European Automobile Manufacturers' Association
ANWB	Algemene Nederlandse Wielrijdersbond (Royal Dutch Touring Club)
BOVAG	BOnd Van Automobielhandelaren en Garagehouders (Dutch association of car dealers and garage holders)
CC	Common Criteria
CRM	CRM automotive retail
CECRA	European Council for Motor Trades and Repair
CPA-SR	Cech predajcov a autoservisov SR (Association of vendors and car repair shops in Slovakia)
DG SANCO	European Commission’s Directorate-General for Health and Food Safety
DMV	US Department of Motor Vehicles
EC	European Commission
ECC-NET	European Consumer Centres Network
ECU	Electronic Control Unit
EP	European Parliament
ERA	European Research Area
EReg	Association of European Vehicle and Driver Registration Authorities
EU	European Union
EUCARIS	European Car and driving license Information System
EU13	The Member States which joined the EU after 2004
EU15	EU Member States before the 2004 enlargement

ERA	European Research Area
ERRU	European Register of Road Transport Undertakings
EVITA	"E-safety vehicle intrusion protected applications" project
FIA	Fédération Internationale de l'Automobile
GRSG	Working Party on General Safety Provisions
HSM	Hardware Secure Module
JEVIC	Japan Export Vehicle Inspection Center
JOC	Japan Odometer Check
ISO	International Standard Organisation
IT	Information Technology
ITS	Intelligent Transport Systems
LCV	Light Commercial Vehicle
MoU	Memorandum of Understanding
MPI	Market Performance Indicator
NAP	Nationale AutoPas
NHTSA	US National Highway Traffic Safety Administration
OBD	On-Board Diagnostics
OICA	International Organisation of Motor Vehicle Manufacturers
PP	Protection Profile
PRESERVE	"Preparing Secure Vehicle-to-X Communication Systems" project
PTI	Periodical Technical Inspection
RDW	Rijksdienst voor Wegverkeer (Dutch Government Road Transport Agency)
RTÉ	Raidió Teilifís Éireann (Radio and Television of Ireland)

SHE Secure Hardware Extension

SPF Service Public Fédéral

ST Security Target

TOE Target of Evaluation

TűV Technischer Überwachungsverein (Technical Inspection Association)

UAE United Arab Emirates

UNECE United Nations Economic Commission for Europe

UK United Kingdom

US United States

VHR Vehicle History Report

VIN Vehicle Identification Number

VIP Vehicle Information Platform

VM Vehicle Manufacturer

VNA Vereniging van Nederlandse Autoleasemaatschappijen (Association of Dutch vehicle leasing companies)

vzw Vereniging zonder winstoogmerk (association without lucrative purpose)

V2I Vehicle-to-Infrastructure

V2V Vehicle-to-Vehicle

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EXECUTIVE SUMMARY

Odometer tampering is a malpractice that involves an unauthorised manipulation of mileage readings shown on odometers**.** Its aim is to create the impression that the motor of a vehicle has a lower mileage than it does in reality, which in turn leads to a higher re-sale price of the vehicle.

Estimations of the scale of the phenomenon differ considerably between Member States (ranging from 10% to more than 50% of the total number of cars traded in the second-hand markets) (Montag, 2017; Bellucci, 2015; Ereg 2014a). The malpractice is even more relevant in **cross-border trade** of used vehicles. This is mainly due to the **lack of effective cooperation at supranational level** and an insufficient exchange of information on mileage readings of odometers in vehicles traded between Member States. Cars with rolled-back odometers are estimated to account for between 30% and 40% of total number of vehicles traded across borders (CRM, 2010). These numbers prove that odometer tampering is a **serious concern and a widespread phenomenon across Europe**, affecting almost all second-hand car markets in the European Union (EU).

Obviously, **consumers are financially affected** by odometer manipulations. In the EU alone, their losses resulting from the rollback of vehicles' mileage are estimated at several billion euros every year. Moreover, odometer tampering has profound negative effects on **safety** of road users and on the **environment**. In practice this means that cars, which have been heavily used and subject to a lot of wear and tear are sold at prices higher than their real value. To make matters worse, these cars encounter more frequent than expected technical problems and perform poorer in terms of pollutant and emission standards.

Surveys conducted in the past few years by the European Commission (European Commission, 2016a; European Commission, 2014) prove that, among the various markets taken into consideration for the purposes of the statistic, the whole **second-hand car market sector was ranked the lowest in terms of trust by European consumers**. The reasons are manifold, but the unavailability of information on accurate odometer readings is mentioned as one of the most critical by customers.

In recent years, odometer tampering gained more attention from consumers, public institutions and international associations, as they all have become increasingly aware of the harmful consequences of this malpractice. At the European level, the problem was addressed for the first time in the so-called **"Roadworthiness Package" of 2014**[1], where the Member States were obliged to adopt specific measures to **collect and register mileage readings at every Periodic Technical Inspection (PTI)**. However, Member States are free to decide when the first mileage recording is conducted for the new vehicle as the Directive 2014/45 determines only that the first PTI should not occur later than four years. As a result, in most Member States the four-year grace period is considered to be an issue, particularly in the case of vehicles that are used intensively and with a high mileage, where the temptation to roll back the odometer is the strongest.

[1] The "Roadworthiness Package" consists of three Directives: 2014/45/EC of the European Parliament and of the Council of 3 April 2014 on periodic roadworthiness tests for motor vehicles and their trailers and repealing Directive 2009/40/EC, 2014/46/EC on registration documentation for vehicles and trailers and 2014/47/EC on roadside inspections. All three Directives entered into force on 20 May 2014 and Member States must have put in place national legislation to comply with the legislation by 20 May 2017, and must apply the main provisions of the legislation from 20 May 2018 at the latest as far as the requirements of the Directive 2014/45/EU is concerned.

The "Roadworthiness Package" was followed by **Regulation (EC) No 2017/1151**[2], which entered into force in June 2017. It requires that the car manufacturers effectively deter reprogramming of the odometer readings. This is expected to be achieved primarily through the implementation of systematic anti-manipulation strategies by the vehicle producers. Moreover, methods giving an adequate level of tamper protection shall be approved by the relevant EC-type approval authority.

On top of the obligations resulting from the EU legislation mentioned above, some Member States have decided to introduce additional measures to minimise odometer manipulations. For the purpose of this study, best practices implemented in Belgium and the Netherlands have been analysed in more detail, as they have proven to be particularly effective. In Belgium, the implementation of the **"Car-Pass" system contributed substantially to nearly eradicating the odometer tampering in the domestic market.** According to Car-Pass vzw's data, the percentage of unauthorised manipulations of odometer readings in Belgian-registered cars dropped from 8.6% in 2006 to 0.2% already after two years, and remained basically unchanged until 2016. Similarly, the Dutch **Nationale AutoPas (NAP) system resulted in substantial reductions of odometer manipulations**, which in 2016 accounted for only 1% of total second-hand vehicles traded in the domestic market. Inspired by the Belgian and Dutch experiences, a new legislation is expected to be adopted in Slovakia and should enter into force by March 2018. Additional information on the situation in Luxembourg and Germany is also reported in this study.

Since November 2016, the authorities responsible for the management of the Belgian and the Dutch systems (i.e. Car-Pass vzw in Belgium and Road Transport Agency -RDW- in the Netherlands) **have been exchanging odometer mileage readings** of the second-hand vehicles traded between the two countries. Within the first few months of implementation, the two organisations were able to detect many manipulations that were not possible to be identified before the cooperation had started. Consequently, the number of odometer manipulation cases has been decreasing even further. A **similar cooperation** is in place **between the Netherlands and Slovakia**, where a system comparable to the "Car-Pass" is expected to be implemented from 2018.

Outside Europe, odometer tampering has been addressed by mostly **private-led initiatives** implemented in the **US, Japan and New Zealand.** These initiatives aim at providing customers - who request it - with a detailed Vehicle History Report (VHR) of the vehicle they wish to buy. The VHR includes odometers reading data among other information concerning a particular vehicle.

Information Technology (IT) can contribute to the eradication of odometer tampering, thanks to **hardware and software- based solutions** that can further safeguard odometers from unauthorised manipulations. These **technological** solutions are **available at reasonable prices**, and vehicle manufacturers, as well as suppliers of vehicle components, are free to choose the technology used to address the problem of odometer tampering as long as they comply with the relevant regulations.

Based on the study's findings, the following recommendations are proposed. They include both regulatory aspects, as well as solutions based on the technology available.

[2] Commission Regulation (EU) No 2017/1151 of 1 June 2017, supplementing Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information, amending Directive 2007/46/EC of the European Parliament and of the Council, Commission Regulation (EC) No 692/2008 and Commission Regulation (EU) No 1230/2012 and repealing Commission Regulation (EC) No 692/2008.

Recommendations

1. **Shortening of the maximum four-year period after which the first recording of the odometer readings is made**

   The maximum four-year time lapse between the registration of a new car and the first PTI - as laid down in the "Roadworthiness Package" - is considered to be too long, as it leaves fraudsters a lot of time to tamper with odometers, especially on the newest cars with high mileage exploited in the first years. The first mandatory PTI after 3 years already adopted in some countries could be embraced at EU level. Nevertheless, such a measure, if taken in isolation, would have only a limited effect, as it would simply reduce the time interval in which the odometer manipulation could take place.

2. **Inclusion of additional measures within the EU legislation**

   The mandatory (or at least recommended) requirement of mileage registration not only at PTIs, but also at each maintenance and service, should be considered as an additional measure to be included in the EU legislation. This is a key success factor in the initiative undertaken in Belgium. Considering that this data is often already recorded for maintenance planning purposes, the additional burden on operators might not be too heavy.

3. **Promotion of implementation of systems based on the national best practices**

   Member States should be encouraged to take stock of the successful experiences of other countries both from within ("Car Pass" and RDW activity) and outside of the EU. Regulatory systems that have been implemented in Belgium and the Netherlands have proved to be very effective in tackling odometer tampering, since they contribute to the creation of a more transparent framework at national level, defining clear rules and responsibilities for all the stakeholders involved in the second-hand car market. These systems could be adapted to the specific markets and legislative frameworks in various Member States.

4. **Encouragement of data exchange on odometer readings between Member States**

   The lack of cooperation between the Members States is the main reason why the share of the tampered odometers is the highest in the second-hand vehicles that are traded across countries' borders. In this context, once again the experiences of Belgium and the Netherlands have proven to be effective. The existing EU-wide platforms (such as EUCARIS) could be used to facilitate the exchange of information between Member States on odometer readings avoiding duplications of databases and at the same time ensuring cost-effectiveness. Since data protection rules are different among EU countries, this may entail the adaptation of some Member States' legislation in order to allow for the data exchange on a common platform.

5. **Monitoring the effectiveness of the provisions laid down in Regulation (EC) No 2017/1151**

   The EU legislation has recently seen the entry into force of the Type-approval Regulation (EC) No 2017/1151, which put stricter requirements on technology security for odometer recording equipment. The technology solutions adopted by car manufacturers and car component suppliers should guarantee that the objectives of the EU legislation are met and the right of EU consumers when buying a second-hand car (irrespective of the origin of the car) is safeguarded. The effectiveness of the technical solutions adopted should be evaluated in the years to come by setting up a dialogue with the industry and by monitoring the reduction of the odometer tampering malpractice.

1. INTRODUCTION

1.1 Purpose

The objective of this study is to provide an overview of odometer tampering in motor vehicles in the EU and to explore the most relevant best practices, measures, tools and technical solutions to prevent it. The interlinked objectives of the study are:

- to describe the phenomenon of odometer manipulations and to estimate its scale in the EU;
- to provide an overview of best practices employed by individual Member States in their efforts to minimise odometer manipulation;
- to analyse the possibilities of using the latest technologies for the purpose of further limiting or eliminating odometer rollback practices in road vehicles in the EU;
- to evaluate the need for possible modifications of existing EU legislation to further limit manipulations of odometer in road vehicles and, hence, to improve the safety of road transportation.

1.2 Methodology

The study has been carried out by combining desk-research activities – i.e. searching for data and analysis among sources ranging from international institutions to technical journals – with direct interviews, in order to collect first-hand expertise from those who are directly involved in the topic. Considering the scope of the study and the diffusion of the odometer tampering across borders, most of the stakeholders contacted were from European and international organisations. A complete list of contacted stakeholders is provided in Annex A.

1.3 Structure of the study

The document is organised in four main sections according to the four objectives of the study. Section 2 provides a general description of odometer tampering, its main features and some overall statistics about the phenomenon across the EU. Section 3 focuses on the most relevant best practices implemented within the EU, explaining how they work, their achievements and the reasons of their success. It also includes an overview of the relevant initiatives undertaken outside Europe. Section 4 illustrates the technology solutions currently available on the market that might contribute to the further limitation of odometer tampering. Section 5 summarises the most relevant aspects that have emerged in previous sections, and makes recommendations about what could be done at the EU level to fight the odometer tampering more effectively. The final part of this paper contains the lists of references, websites and annexes, i.e. all sources of information examined in the preparation of this study.

2. ODOMETER MANIPULATION IN THE EU

KEY FINDINGS

- **Odometer tampering,** i.e. the practice of deliberately altering the real mileage of a motor vehicle, **is a widespread phenomenon** across Europe, particularly when vehicles are traded among different countries.
- For many years, the **market for second-hand used cars** has been regularly registering the **lowest level of trust** among EU consumers in comparison to other sectors. **Lack of information** provided to customers **about accurate odometer readings** is mentioned as one of the most critical issues.
- Recently, the phenomenon has gained increased attention at European and international level. As a result, the number of **specific legislative and other measures have increased progressively** in an attempt to combat this dishonest practice.

2.1. The quantification of the phenomenon

The odometer, or odograph, is an instrument for measuring the distance travelled by a vehicle; it may be electronic, mechanical, or a combination of the two. Odometer tampering[3] constitutes the practice of deliberately altering the real mileage of a given motor vehicle, making it appear lower than it is in reality.

Odometers are tampered in order to artificially increase the economic value of used cars. The economic profit is remarkable, considering the relative ease of carrying out this deceptive practice and its potential margins. According to the Fédération Internationale de l'Automobile (FIA) and the Association of European Vehicle and Driver Registration Authorities (EReg) (FIA, 2014; EReg 2014a), ad-hoc devices for odometer manipulation are available on the internet for a few hundred euros[4], allowing even non-experts to roll back the real mileage of a vehicle without any particular effort.

The consequences for customers are significant: not only they do acquire a vehicle which has actually been more heavily used than they have been told, but they are also likely to face unexpected mechanicals troubles – and their associated costs – in the near future due to the past heavy use of their vehicles. Further implications concern the safety of road users and the worse environmental performance of the vehicles. The wrong values of mileage prevent a vehicle's owner to correctly plan and carry out maintenance and repair of specific parts and components of the vehicle at the right time. Moreover, vehicles that have had a much heavier use are also likely to be much less efficient in terms of pollutant and carbon emissions, contributing to a worsening air quality and health of the European citizens.

[3] Known also as "busting mileage" in the US or "clocking" in the United Kingdom (UK) and the Republic of Ireland.

[4] A Google search for the words "odometer correction services" generated more than 400 000 hits (accessed on 14/07/2017).

A comprehensive study conducted by CRM automotive retail (CRM) on behalf of Car-Pass vzw in 2010, which focussed on the data from five countries (Germany, France, the Netherlands, Belgium and Luxembourg), estimated "low" and "high" mileage fraud scenarios to be 5% and 12% respectively (CRM, 2010). These figures were later acknowledged as representing the minimum and maximum values by the European Parliament in recital 23 of the proposal adopted for a regulation on periodic roadworthiness tests for motor vehicles and their trailers (European Parliament, 2013). It states that odometer fraud is considered to affect between 5% and 12% of used car sales at national level, causing relevant costs for European consumers every year.

The figures are very different in relation to second-hand car sales involving cross-border transactions. CRM indicates values between 30 and 50% as an indicative range of tampered cars sold (CRM, 2010; EReg 2014a). The corresponding economic damage of odometer tampering can be quantified as a cumulative loss of EUR 1.4–2.8 billion in Belgium, France, Germany, Luxembourg and the Netherlands (CRM, 2010). The same source estimates that the economic damage for the whole of the EU could range between EUR 5.6 and 9.6 billion, including both the excessive price of the vehicle and the increase in maintenance and repair costs.

Additional data providing interesting information on the scale of odometer tampering in various parts of the EU is also available, however it has a more national scope. In **Germany**, the Munich police and the German Technical Inspection Association TÜV Süd estimated that odometer readings were manipulated in about one third of the second-hand vehicles in 2011. They also assessed the resulting economic loss to be at around EUR 6 billion (European Parliament, 2016a), i.e. far higher than the CRM estimate. Research undertaken in **Poland**, the largest importer of used cars within the EU, estimated that the share of tampered cars reaches 15% (Montag, 2017). Tomáš Zdechovský, a Czech Member of the European Parliament, reported that, as of 2014, 37% out of 220 000 second-hand cars sold in the **Czech Republic** had an odometer that was artificially manipulated (Euractiv, 2017). In **Italy**, according to data provided by Automobile Club of Italy (ACI), about 2 500 000 second-hand cars were sold annually between 2011 and 2013. An investigative book on the topic, published in 2015, estimated that the number of tampered cars sold in the Italian market amounts to 50% (Bellucci, 2015). In **France**, according to estimations made by the "Association 40 millions d'automobilistes", around 600 000 second-hand cars (or 11.3%) out of 5 300 000 sold in the French market in 2013 had their odometers rolled back (Le Figaro, 2014). According to the new studies of Cartell.ie (2017)[1] and RTE (2017), 11% of second-hand cars for sale in the **Republic of Ireland** display a false mileage. The figure is even worse for cars imported from the UK, where nearly 18% of them have "*an unreliable or questionable mileage reading*"[5]. (Cartell.ie 2017; RTÉ 2017). Finally, in the **UK**, the Government's economic regulator estimated that 5-12.5% of cars had a mileage discrepancy in 2010 (EReg, 2014). These statistics, however, seem to be quite optimistic in the opinions of the majority of experts interviewed for the purpose of this research.

A report published in 2015 by the European Consumer Centres Network (ECC-Net, 2015) and quoted by the European Consumer Centre France and Germany, confirmed that even though odometer manipulation is prohibited in 26 Member States, only ten of them have proposed solutions allowing customer to verify a vehicle's mileage before its purchase

[5] Cartell.ie holds the most complete vehicle database in Ireland. The study has been developed in cooperation with AA Ireland.

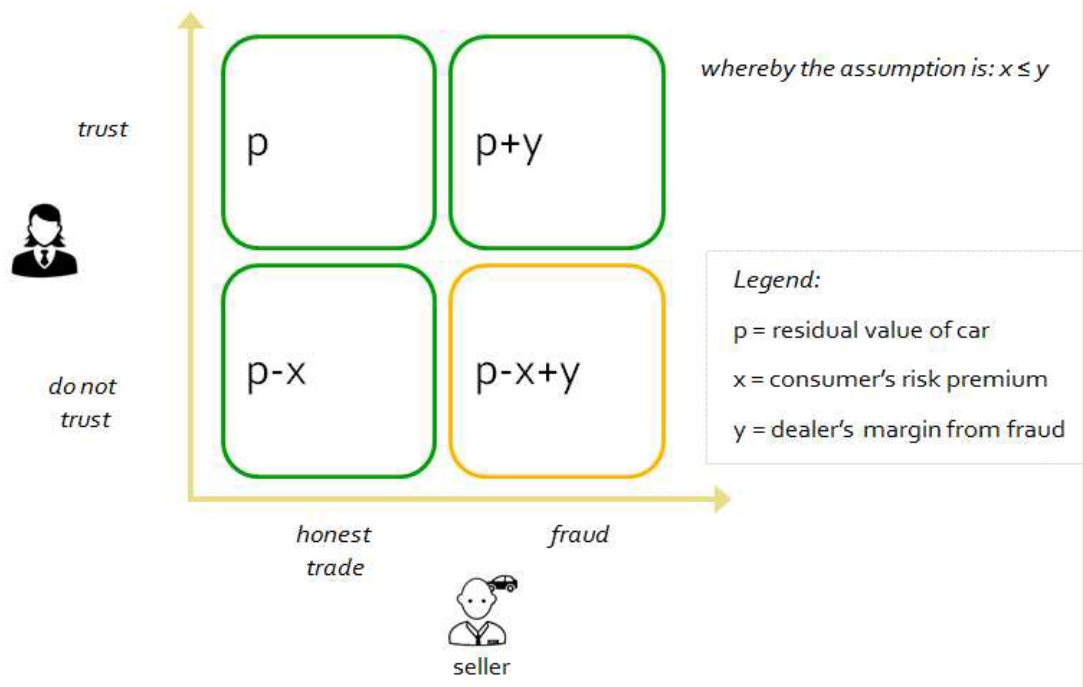
(European Consumer Centre France, 2017). Out of these ten countries, eight propose that the buyer consults a national mileage registry of registered vehicles. Belgium and the Netherlands are the only two countries that oblige sellers to provide a certificate to buyers at the time of sale, specifying the vehicle's mileage.

Box 1: Mileage rollback and risk premium

A study conducted by PwC on behalf of Car-Pass vzw summarises the potential set of combinations in terms of trust of the buyer and, in particular, honesty of the seller that a buyer and a seller can face when a second-hand car is sold (PwC, 2016). As previously indicated, the margins that a seller can make from odometer tampering may be significant, amounting to several thousand euro. Assumed that "p" represents the real value of the vehicle when it is sold, a car with ostensibly lower mileage can be sold at an artificial price that is higher than the actual residual value of the vehicle (p + y) provided that consumers are not aware that the odometer might have been tampered with. The set of possible combinations that may arise between buyers and sellers when a used car is sold is presented in Figure 1 below.

Consumers looking for a second-hand car might be aware of this tendency. If so, based on their own experience they know that the phenomenon of odometer rollback exists in the market, but they do not have the expertise required to judge whether the vehicle mileage is reliable. As a consequence, many consumers provide for a "risk premium" of x, i.e. an amount that they have kept in reserve for unexpected vehicle expenses, and that they would deduct from the asking price. However, in many cases this "risk premium" margin is not enough to face the likely extra maintenance and repair costs.

Figure 1: Existing set of options (trust/do not trust; honest trade/fraud) between buyers and sellers

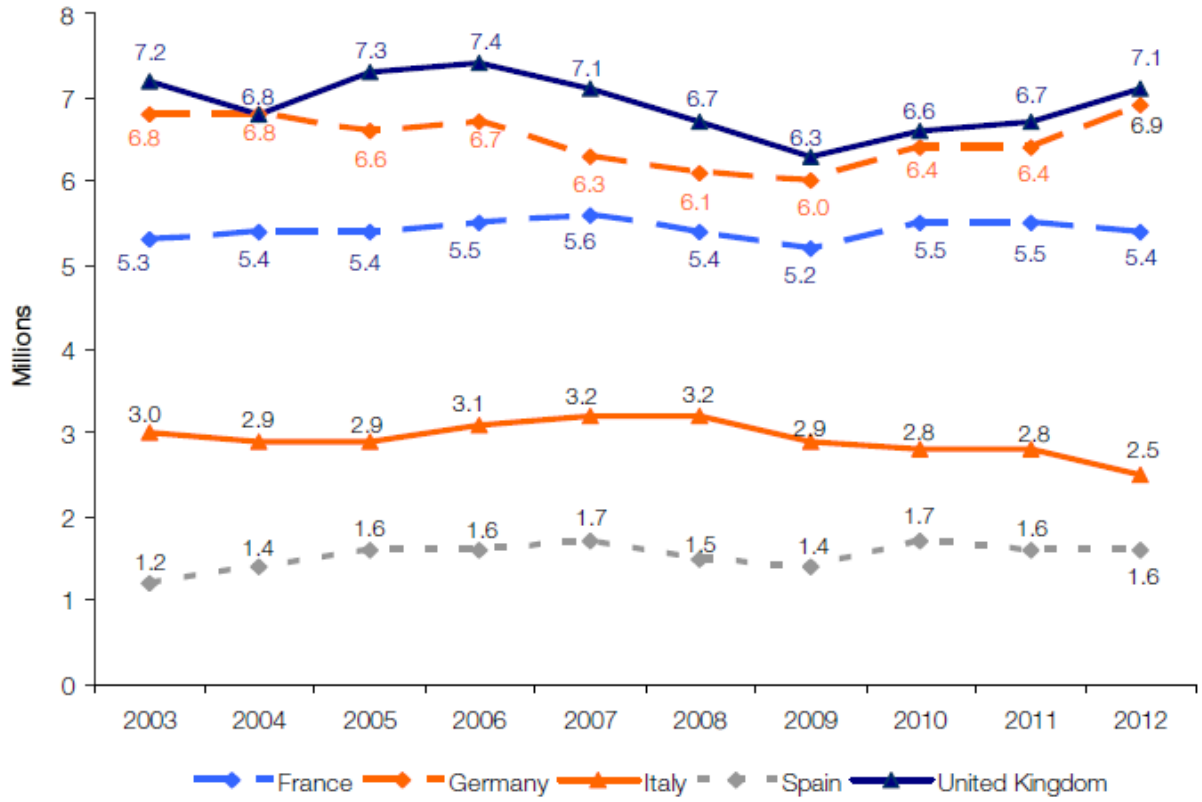


Source: PwC (2016)

2.2. The second-hand car market

Second-hand cars represent the largest share of the automobile market by both value and volume. Indeed, in terms of traded vehicles, the second-hand car market is two to three times larger than the market of new cars (Montag, 2017). According to data provided by national trade bodies (BCA, 2013), in 2012 the five biggest EU markets (UK, Germany, Italy, France, Spain) accounted for over 24 million used car sales as opposed to 9 million new car registrations in the same year. Figure 2 below shows the trend of used car volumes in the five biggest markets between 2003 and 2012. Some comparisons between pre- and post-recession levels can be observed, but, overall, the trend can be seen as rather stable over time.

Figure 2: Used car volumes in EU major markets, 2003 – 2012



Source: National Trade Bodies, BCA (2013)

According to the annual Consumer Markets Scoreboard[6] prepared by the Directorate-General for Health and Food Safety (DG SANCO) (European Commission, 2014), the second-hand car market has the lowest overall score among the goods markets since 2010, demonstrating low consumers trust in the sector. Importantly, the figures highlighted in the study show considerable differences between the Market Performance Indicators (MPIs)[7] for the top and the lowest ranking Member States respectively, with scores generally lower for EU13 countries as compared to EU15.

[6] The Consumer Markets Scoreboard surveys consumers with recent purchasing experiences in order to track the performance of over 40 consumer markets.

[7] The 'Market Performance Indicator' (MPI) is a composite index taking into account five key aspects of the consumer experience: comparability, trust, expectations, choice and overall detriment. The five components of the index are weighted on the basis of their relative importance as stated by consumers.

According to the DG SANCO consumer survey mentioned above, traders normally inform customers (either in the vehicle sales advert or directly) on the vehicle's price, age, mileage, engine size, transmission type and the condition of car's interior and exterior. However, specific data collected from survey respondents in the DG SANCO study confirm that consumers trust vehicle dealers less with regard to mileage readings and odometer accuracy.

In fact, approximately 34% of consumer survey respondents did not receive or did not know if they had received information on vehicle mileage checks when buying their second-hand vehicle (without taking into consideration countries like Belgium and the Netherlands, where legislation obliges dealers to prove the correctness of odometer readings).

When informing customers on odometer accuracy, car dealers most commonly used the following methods:

- a presentation of the vehicle's service history/logbook (33%)
- a demonstration of an official certificate such as the "Car-Pass" (14%)
- a verbal assurance (18%)
- a possibility for consumers to visually check the odometer themselves (12%).

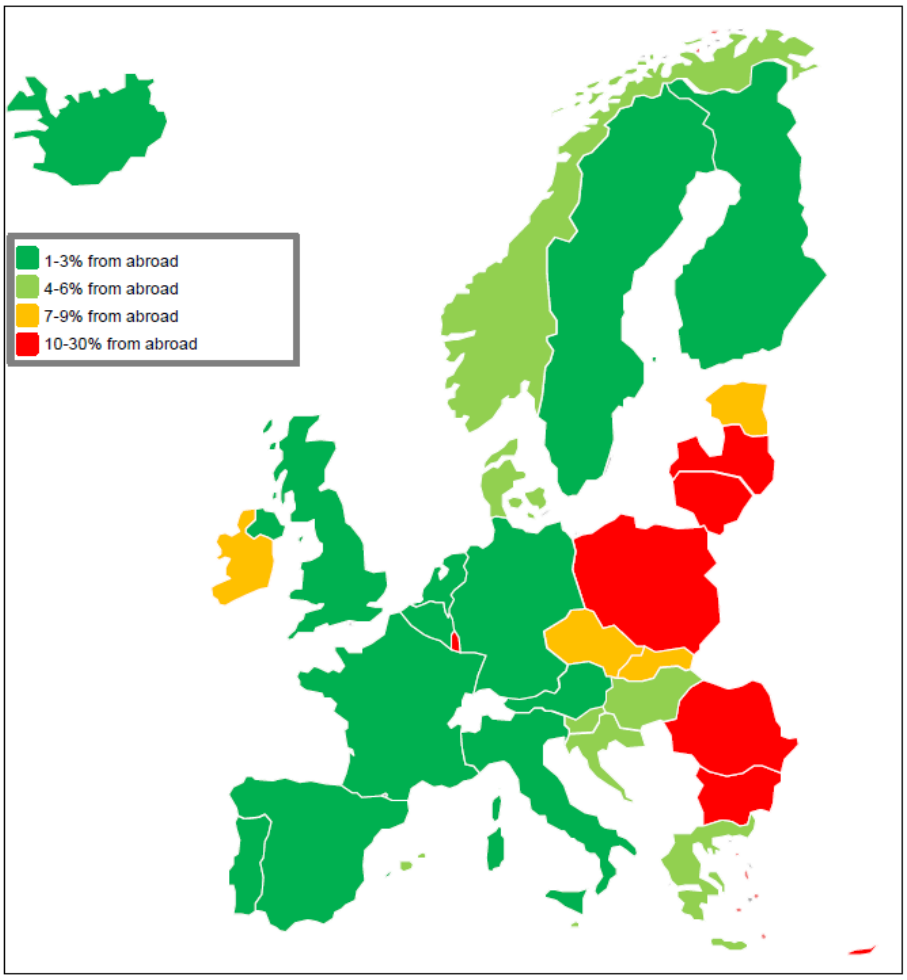
Evidence from the Consumer Market study on the functioning of the market for second-hand cars from a consumer perspective (European Commission, 2014) shows that about two-fifths of consumer respondents reported experiencing at least one problem within a year after buying their second-hand car, beyond expected wear and tear[8]. The most common types of problems were: battery/electrical problems (experienced by 15% of all buyers), problems with tyres, wheels and suspension (12%) and problems with brakes and with the car exterior/bodywork (both 10%).

In some EU13 countries, certain problems related to safety were reported two or three times more frequently as compared to the EU average of 5%. Between 15-20% of all respondents in Bulgaria, Romania and Poland reported experiencing odometer tampering, whereas two out of ten respondents from Hungary, Poland, Romania and Lithuania reported undisclosed accident damage.

As cross-border transactions have proved to be more frequently affected by odometer tampering, it is worth analysing the cross-border trade rate in the EU. This may explain some differences noted between the EU Member States. Overall, 3.6% of all consumers surveyed had bought their second-hand car from abroad in 2014 (European Commission, 2014). However, figures vary considerably between EU15 and EU13. In the same year, 1.7% of respondents in EU15 countries bought their cars from abroad, while in EU13 countries this group of cars accounted for 12.6%. More precisely, the countries with the highest proportion of second-hand cars imported directly by consumers included Romania (30%), Malta (27%), Luxembourg (18%), Bulgaria (16%), Cyprus (15%), Latvia (14%), Poland (13%) and Lithuania (12%) (European Commission, 2014).

[8] The damage that happens to an object in ordinary use during a period.

Map 1: Proportion of second-hand cars purchased cross-border



Source: European Commission (2014)

2.3. The EU legislation

The EU institutions have increasingly focussed on the problem related to odometer tampering and its economic impact on the second-hand car market, as well as on road safety and environment. Several pieces of legislation have been enacted over the past few years by the EU in an attempt to provide progressively stricter provisions to combat the diffusion of the phenomenon across Member States. They are briefly summarised below.

2.3.1. The "Roadworthiness Package"

The European Commission (EC) has addressed odometer tampering for the first time within the EU in the "Roadworthiness Package". In July 2012, the EC presented its proposal for a Regulation of the European Parliament and of the Council on periodic roadworthiness tests for motor vehicles and their trailers, repealing Directive 2009/40/EC. The package aimed at better harmonising and regulating the required roadworthiness tests (e.g. frequency and quality), roadside inspections and rules on the registration of motor vehicles.

The European Council of Transport Ministers endorsed those principles in December 2012, with the support of the European Parliament (EP), who took a clear position in favour of anti-odometer tampering measures. The EP reiterated the importance of an electronic vehicle information platform to exchange data related to roadworthiness testing and odometer readings between the Member States.

A political agreement between the Commission, the Council and the EP was reached in December 2013. The EP adopted the "Roadworthiness Package" during its plenary session on 11 March 2014.

The "Roadworthiness Package" consists of three directives of the EP and of the Council, comprising Directive 2014/45/EC on periodic roadworthiness tests for motor vehicles and their trailers and repealing Directive 2009/40/EC, Directive 2014/46/EC on registration documentation for vehicles and trailers and Directive 2014/47/EC on roadside inspections. The "Road Package" obliges Member States to implement measures to register the odometer readings of all vehicles at each PTI. The odometer readings obtained must be stored in a central database, at national level, in order to provide the basis for further cross-border exchange of this information once the connection of national registers is operational.

In many EU Member States (i.e. 12 out of 27), the first PTI takes place four years from the registration of the vehicle (European Commission, 2012). After that, further PTI checks become more frequent as vehicles get older (the following ones after two years and then annually).

However, according to the majority of the experts interviewed[9] in the course of the research, the time between the vehicle's (car or light commercial vehicle - LCV) registration and the first PTI still remains very long, offering plenty of opportunities to manipulate odometers either just before the first PTI takes place or at any other point in time prior to it. The PTI then registers and officialises incorrect values of odometers. Moreover, it is also possible to tamper with odometers between further inspections, as the odometer reading can be set back to the level only slightly above the last registered value, before the following check takes place.

2.3.2. Regulation (EU) No 2017/1151

On 1 September 2017, new EU rules to prevent odometer manipulation have come into effect. Regulation (EU) No 2017/1151[10] (the so-called Type-approval Regulation) obliges manufacturers to design and market new vehicle types that are more robust against odometer manipulation. The relevant provision of the regulation stipulates that:

"*manufacturers shall effectively deter reprogramming of the odometer readings, in the board network [wiring system], in any powertrain controller as well as in the transmitting unit for remote data exchange if applicable. Manufacturers shall include systematic tamper-protection strategies and write-protect features to protect the integrity of the odometer reading. Methods giving an adequate level of tamper protection shall be approved by the approval authority"*[11].

[9] This includes in particular representatives of the Belgian Car-Pass vzw, Dutch Government Road Transport Agency (RDW), Fédération Internationale de l'Automobile (FIA) and European Council for Motor Trades and Repair (CECRA).

[10] Commission Regulation (EU) No 2017/1151 of 1 June 2017, supplementing Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information, amending Directive 2007/46/EC of the European Parliament and of the Council, Commission Regulation (EC) No 692/2008 and Commission Regulation (EU) No 1230/2012 and repealing Commission Regulation (EC) No 692/2008.

[11] Annex 1 « Administrative provisions for EC-type approval », point 2.3.3.

Therefore, it has become compulsory for the vehicles' manufacturers to employ systematic anti-manipulation and write-protection strategies to ensure the integrity of mileage data (Fleeteurope, 2017).

From September 2017, only vehicles that have an odometer "adequately protected" against odometer tampering will receive EU-type approval by the Member States authorities.

To boost an independent servicing market, the type approval regulation also includes a provision ensuring that a vehicle's on-board diagnostics[12] port will be open for access to repair and maintenance information. Some vehicle manufacturers were in favour of closing the port, or restricting access to it, so they could control who is allowed to fix the vehicles (Autovistagroup, 2017). The new rules are expected to provide further impetus to the development of stronger protection to odometers, and make tampering more complicated.

[12] On-board diagnostics (OBD) is an automotive term referring to a vehicle's self-diagnostic and reporting capability. OBD systems give the vehicle owner or repair technician access to the status of the various vehicle subsystems. Two different types of on-board diagnostics can be distinguished, i.e. OBD-II and OBD-I, which vary in terms of technological solutions used.

3. BEST PRACTICES TO MINIMISE ODOMETER MANIPULATION

KEY FINDINGS

- In **Belgium**, the implementation of the **"Car-Pass"** system since 2006 has **contributed to almost eradicating odometer tampering** across the country. In 2016, it accounted for less than 0.2% of all "Car-Pass" certificates issued.
- In **the Netherlands**, remarkable results have been achieved through a progressive set of actions started in the 1990s and aimed at combating odometer tampering. Since then, quantity of **manipulations has been constantly decreasing** to reach only 1% of the total number of cars traded within the Dutch market in 2016.
- In the EU, the information on **mileage readings has only recently started to be exchanged** at cross-border level, particularly between Belgium and the Netherlands and between the Netherlands and Slovakia. **The initial few months of this cooperation seem to be promising**, as a further reduction of the rate of odometer tampering cases has been observed.
- **Private companies operate in the US and Japan** to provide vehicle history reports including odometer reading data.

3.1. Best practices in individual Member States

In the EU, two successful initiatives have been implemented at national level over the last decades to limit odometer tampering: the Belgian "Car-Pass" and the Dutch "Nationale AutoPas" (NAP). Although other Member States considered the implementation of similar initiatives, at the time of writing of this study, no concrete evidence existed, except for Slovakia, that similar systems will be implemented soon in other EU countries.

3.1.1. "Car-Pass" in Belgium

3.1.1.1. How it started

In the 1990s, odometer tampering was a serious concern in Belgium, undermining consumers' trust in the second-hand car dealers. Before 2006, the Belgian technical inspection recorded more than 60 000 cases a year where the odometer reading was lower than the value recorded at the previous year's inspection of the car[13]. Under the pressure of many professional car dealer associations, the first legislative measures came into force in 2000. Under the Act of 12 March 2000, it became forbidden to change the mileage shown on the odometer of a vehicle. The Act specified, among others, that:

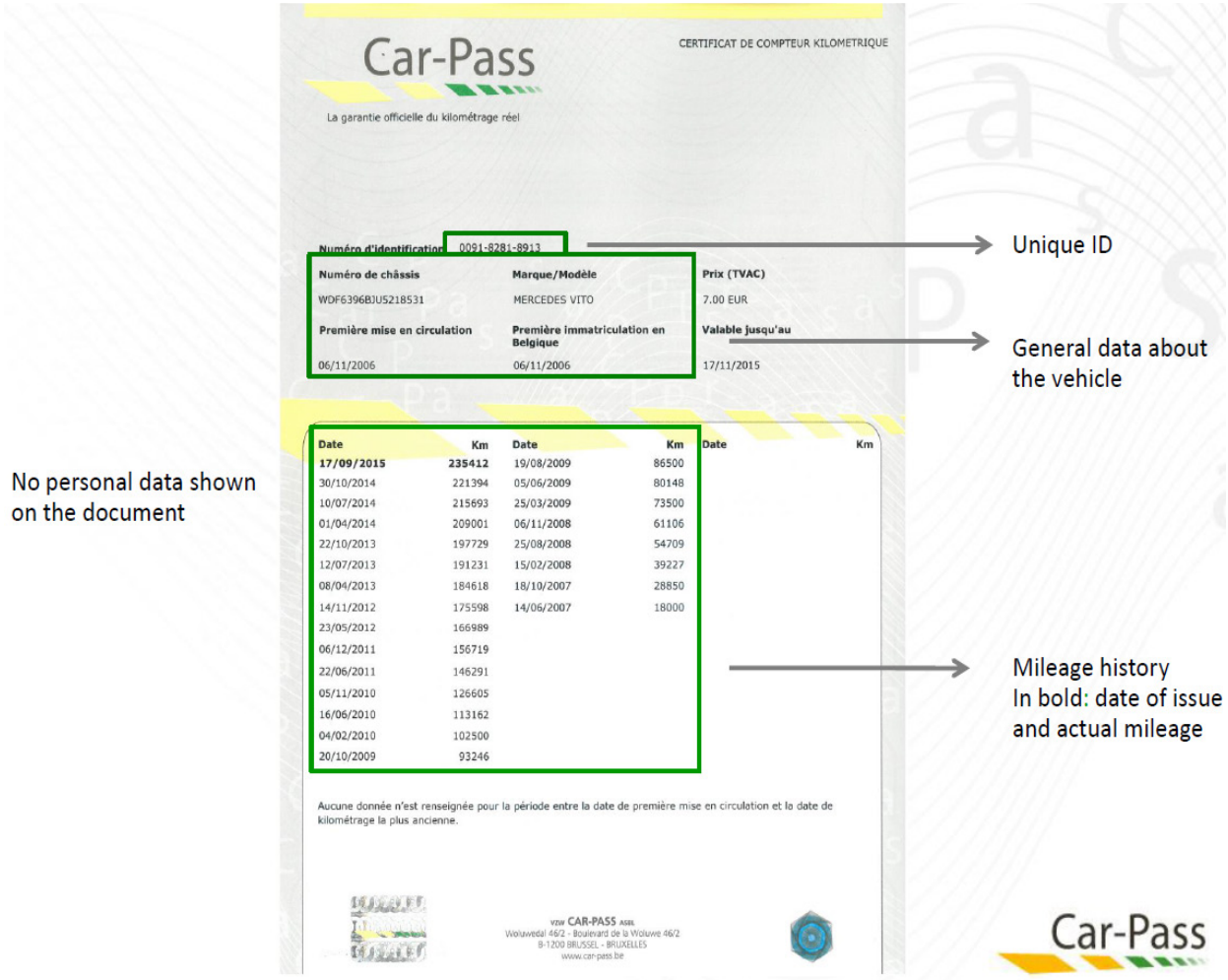
- all professional dealers of second-hand motor vehicles were obliged to state the value of the odometer reading on the invoice when selling the vehicle (Article 4, §1),
- it became compulsory to have a maintenance booklet in the vehicle (Article 4, §2) and
- each garage owner had to complete the maintenance booklet and enter the vehicle's odometer reading every time a car maintenance was carried out.

This first Act did not produce considerable effects. Many old vehicles either did not have a maintenance booklet, or had a booklet with a limited history dating from 2000 onwards. In addition, maintenance booklets were filled in by hand and there was no standardised format. The following legislative intervention took place in 2004, when a new Act (repealing the previous one) made it mandatory for the seller to hand over a "Car-Pass" certificate when selling the vehicle. The 2004 Act gave rise to the enactment of a host of ministerial decrees that formed the basis of a comprehensive enforcement and control system, carried out inter alia by the federal judicial police, the Economic Inspectorate of the Federal Public Service Economy and Car-Pass vzw.

3.1.1.2. How it works

A "Car-Pass" is a document that shows the odometer history of a vehicle, i.e. the registered odometer readings and the dates when they were recorded.

Figure 3: Sample of "Car-Pass" certificate



Source: Car-Pass vzw (2016)

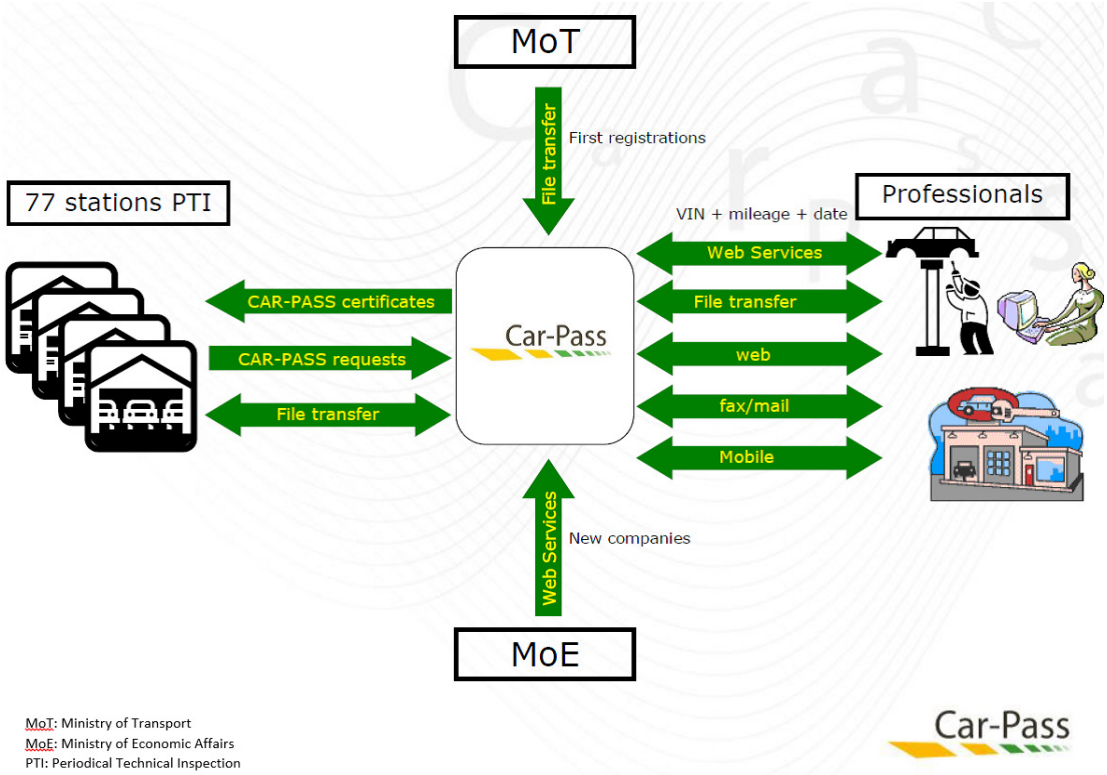
[13] This number did not include potential cases of odometer tampering for second-hand cars less than four years old that, according to Belgian law, do not have to be inspected annually, nor did it include imported cars.

The document also contains other information such as:

- the manufacturer and the model of the vehicle;
- the date on which the vehicle was first registered in Belgium;
- the Vehicle Identification Number (VIN) of the vehicle;
- the date on which the document was issued;
- the ID number of the "Car-Pass" (which enables checking the authenticity of the document). The "Car-Pass" document is managed by Car-Pass vzw, an independent non-profit association established by Belgian automotive branch organisations as well as representatives from Federal Government public offices (the Ministry of Economic Affairs and the Ministry of Transport). In 2017, a "Car-Pass" certificate fee is EUR 7.20 and the expense is borne by the car owner[14].

Mileage readings are collected at each maintenance and service, at each mechanical, electrical, electronic repair, or replacement and assembly of parts, components or accessories of the vehicle. The collected data have to be forwarded to Car-Pass vzw by means of specific business software or by entering the data through the Car-Pass vzw website.

Figure 4: Conceptual scheme of the overall functioning of the "Car-Pass" system



Source: Car-Pass vzw (2016)

The "Car-Pass" system was successful right from the outset. After more than ten years since its implementation, it can be stated that odometer fraud in Belgium has become a very marginal phenomenon. According to the data provided by Car-Pass vzw, the percentage of odometer manipulations in the Belgian-registered cars dropped from 8.6% in

2006 to almost 0% already after two years and did not change until 2015 (please see Figure 5 below for more details).

Figure 5: Number of detected odometer manipulations in Belgium, by year[15]

	< 2006	2008	2009	2010	2011	2012	2013	2014	2015
Absoluut	60000	1614	1395	1393	1312	1247	1085	1239	1197
Relatief*		0,24%	0,20%	0,20%	0,19%	0,17%	0,15%	0,17%	0,16%

Source: Car-Pass vzw (2015) and PwC (2016)

The "Car-Pass" main success factors were:

- **awareness campaigns**: at the launch of the system, several awareness campaigns were spread though media (tv, radio) to make the public aware of the problem and inform both citizens and professionals that the situation was going to change soon. After these campaigns, it emerged that 87% of the consumers interviewed had heard of "Car-Pass" and 80% of the respondents also effectively knew what the system entailed. Indeed, "Car-Pass" is well known both among consumers who had already bought a used car (89% of respondents) and among those who were still looking for one (84%) (PwC, 2016).
- **the presence of an adequate legislative framework** that tackled the problem and recognised odometer tampering as a criminal offence.

Box 2: "Car-Pass" milestones

"Car-Pass" milestones

2004: the Act of 11 June 2004 laid the legislative basis;

2006: Car-Pass vzw starts its operations;

2008: the Belgian courts put "Car-Pass" legislation into practice, through (i) convicting a company that refused to report information; (ii) rescinding a sale because the seller had not given a "Car-Pass" to the buyer; (iii) pronouncing stiff penalties for turning back odometers;

2010: launch of the "Car-Pass" Ok label;

2011: 100 million odometer readings registered;

2013: issuance of the five millionth "Car-Pass";

2015: 800 000 "Car-Pass" certificates in a one-year period;

2016: exchange of data at cross-border level with Dutch RDW.

Source: Car-Pass vzw (2016)

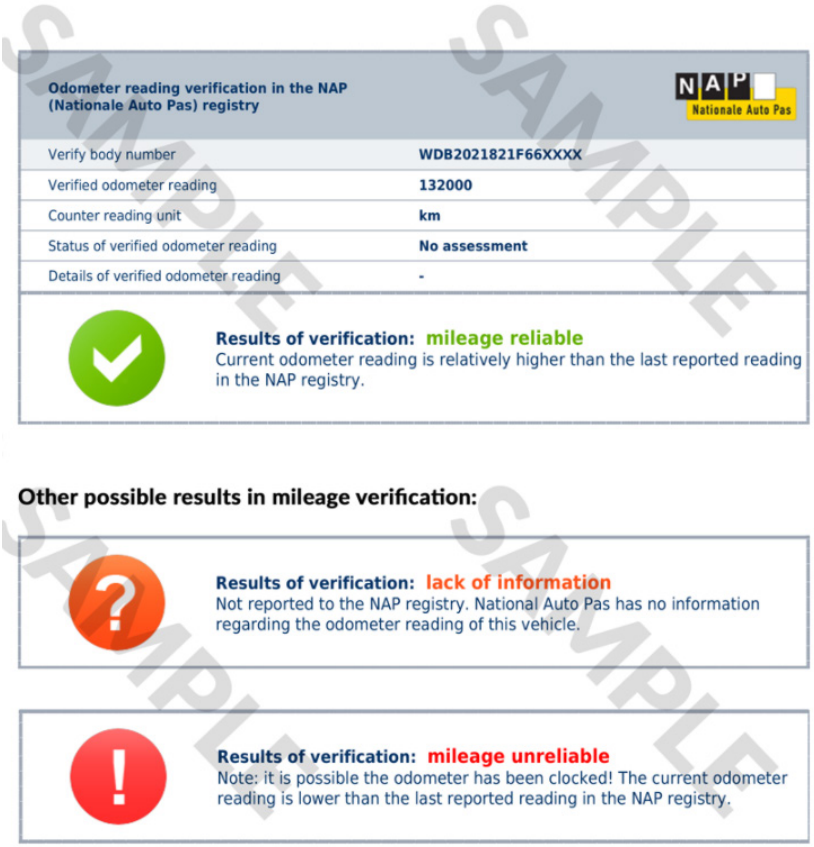
[14] If the "Car-Pass" shows less than four odometer readings, it is free.

[15] Compared to the number of certificates issued, excluding certificates issued for import. According to the Car-Pass vzw annual reports, it is estimated that 60 000 to 100 000 odometers were rolled back in the period prior to the introduction of "Car-Pass".

3.1.2. "Nationale AutoPas" in the Netherlands

The initiative "Nationale AutoPas" (NAP) was started by the automotive sector (BOVAG and VNA) and automobile clubs (ANWB) in 1991. Initially, the system was based on odometer reading registrations operated by accredited garages participating on a voluntarily basis. The legislative intervention to combat odometer tampering more effectively and to better protect consumers took place only a few years ago. The official authority RDW (the National Vehicle and Driving Licence Registration Authority, i.e. an implementing body under responsibility of the Ministry of Infrastructure and the Environment) took over the data management of odometers from the NAP Foundation. Since 1 January 2014, the rollback of odometers is considered a punishable offence in the Netherlands and it is mandatory to notify the RDW of odometer readings for all passenger vehicles and LCVs up to 3.5 tonnes.

Figure 6: Sample of odometer verification in the NAP registry



Source: NAP (2017)

Unlike in Belgium, the database collecting odometer readings in the Netherlands is managed by a governmental agency, the RDW, which is also responsible for a number of other tasks related to the automotive sector[16].

According to the RDW, the percentage of mileage rollbacks has decreased progressively from the time of implementation of the NAP system. At the beginning of the 1990s, mileage manipulations in the country were estimated at 13-14%. Just before the 2014 Law entered

[16] The RDW is an executive agency of the Dutch Government. Data from the following sources are registered: (1) vehicles; (2) their owners / holders; (3) issued documents such as license plates and driving licenses.
The provision of information on these matters to, for example, the police, tax authorities and municipalities is also one of its duties. In addition, the RDW monitors safety and environmental aspects of the Dutch vehicle fleet and creates conditions to prevent fraud and crime.

into force, the odometer tampering reached a level between 8-9%, finally to be reduced to around 1% in 2017. The results achieved so far include:

- a significant increase of mileage registrations throughout the years;
- an improvement of the accuracy of registrations;
- an increase of consumer awareness through intensified use of mileage information products and consumer campaigns.

The success factors of the RDW activity were:

- a **legal framework** with clear and effective sanctions in case of malpractice by sellers;
- a **successful cooperation between public and private stakeholders** at national level, allowing a wide understanding of the problem and the chosen solutions;
- **awareness and information campaigns** addressed to consumers, with the aim to warn citizens of the risks that they can potentially face.

3.1.3. Best practices in other EU countries

In **Slovakia**, a specific legislation to limit odometer rollback is under approval. The changes planned to be introduced in the national legislation should have a significant positive impact on the second-hand automotive market in Slovakia, especially when taking into account its structure. In 2016, the average age of the Slovakian car fleet was around 14 years, i.e. higher than the EU average of 10.7 years old (ACEA, 2015). Based on the data provided by the interviewed expert of the Association of Vendors and Car Repair Shops in Slovakia (CPA-SR), odometer tampering is estimated to affect around 60-70% of the second-hand cars sold in the country in the last years. Moreover, when the exchange of data with the Netherlands started in March 2016, it was estimated that 37% of vehicles imported from the Netherlands had manipulated odometers (Iris Ident s.r.o. and RDW, 2016).

As reported by the CPA-SR, if the process develops as planned, the new law concerning road traffic under preparation by the Ministry of Transportation and Construction should enter into force no later than 20 May 2018, as prescribed by EU Directive 2014/45/CE. According to Slovakia's Iris Ident s.r.o., the responsible body for the management of EUCARIS in the country, this legislative process will lead to the implementation of a "Car-Pass" based system.

Over the last few years, discussions about the adoption of legislative measures to prevent odometer tampering have taken place in **Luxembourg**. The country's market is characterised by a larger proportion of new premium vehicles, i.e. 59% of the fleet is less than five years old and only 16% is more than ten years old (PwC, 2016) and the average age of the car fleet is 6.2 years (ACEA, 2015). In February 2016, the Minister of Transport of Luxemburg received a Belgian "Car-Pass" delegation to gather information about the system. In October 2016, inspired by the Belgian "Car-Pass" system, all federations of the automotive sector signed a joint statement, in which they affirm that odometer tampering negatively affects the image of the sector and makes fair competition extremely difficult.

At the end of 2016, the Government of Land Niedersachsen (Lower Saxony) in **Germany** approved a resolution, in which it calls on the Federal Government to take action to hamper the odometer tampering. The resolution also makes explicit reference to the Belgian "Car-Pass" system (European Parliament, 2016a).

Furthermore, meetings between a Belgian "Car-Pass" delegation and representatives of the competent authorities of **France** and **Norway** took place over the last few years to exchange information about a potential implementation of a "Car-Pass" based system in these countries.

3.1.4. Exchange of odometer readings between Member States

Two EU-wide systems are currently used to exchange information on transport issues. The first one is the **EUCARIS** (European Car and Driving License Information System), developed in the 1990s, which aims at improving cooperation between the national registration authorities by sharing, inter alia, data related to vehicles and driving licences. Thanks to the nature of data exchanged, this system has a great potential to contribute to a more effective tackling of odometer manipulation in cross-border trade.

The **ERRU** (European Register of Road Transport Undertakings) is another EU-wide system operational from 2013, which permits the EU Member States' competent authorities to exchange information on:

- road transport undertakings,
- their compliance with the rules in force, penalties imposed and
- conditions to be met to become a "road transport operator".

The exchanged information allows improving road transport organisation, setting up measures for more effective control of road transport operators and undertakings, as well as improving road safety (European Commission, 2016b).

On April 2016, the EC presented a study (European Commission, 2015) aimed at evaluating the feasibility of a Vehicle Information Platform (VIP), facilitating the exchange of information between actors and Member States involved in the area of roadworthiness testing, covering both periodic tests and roadside inspections. As concluded by this study, both systems (ERRU and EUCARIS) would be applicable for the purpose of developing an EU-wide information platform.

Although the EC does not own it, the EUCARIS platform may represent a ready-to-use platform to facilitate the exchange of odometer readings collected between the Member States, requiring limited and cost-effective IT adjustments to set-up the necessary framework. Box 3 below provides more insights about the EUCARIS system.

Box 3: EUCARIS information exchange mechanism

EUCARIS (European Car and Driving License Information System) is an initiative of several European countries[17] aiming at improving cooperation between the national registration authorities by sharing vehicle and driving licence data and other transport-related data. Importantly, EUCARIS is not a database but an exchange mechanism that connects the Vehicle and Driving Licence Registration Authorities in Europe. Based on a "peer-to-peer" architecture, the system offers a multilingual web client, in which every country has its own page, developed in its language, through which the operator can send queries to the registries of the other countries. The system offers a flexible "pluggable" framework for services for the secure exchange of data between the national registries.

[17] EUCARIS started in 1994 as a cooperation among national registration authorities from Belgium, Germany, Luxembourg, the Netherlands and UK to fight international vehicle crime and driving licence tourism by means of exchanging vehicle and driving licence information between its members.

Since the development of the EUCARIS system, the number of countries using it and the number of services offered has been growing constantly, given that the decentralised technology of EUCARIS has proven useful for the exchange of other transport-related information based on different legal frameworks. Today, it includes 33 registration authorities (representing all Member States except Sweden, plus Gibraltar, Iceland, Isle of Man, Jersey, Norway and Switzerland), although with different degrees of involvement.
Violeta Bulc, the EU Commissioner for Transport, in her response to a Parliamentary question posed on 31 August 2016, clarified that there are no impediments to the use of the EUCARIS by Member States for exchanging mileage information:
"*The Commission does not prevent the use of EUCARIS or any of its extensions. […] The Periodic Roadworthiness Testing Directive does not include the exchange between Member States of roadworthiness testing information. Nevertheless, Member States are free to exchange such information, including mileage, on the basis of bilateral agreements, as some Member States already do. For this purpose, they are free to use EUCARIS or any other information exchange system (European Parliament, 2016b)*".

In 2017, Belgium, the Netherlands and Slovakia are the only countries that are making use of the EUCARIS platform to also exchange information on odometer readings, based on bilateral agreements.

Sources: EUCARIS' website; European Parliament, (2016b)

As indicated in the previous section, Belgium and the Netherlands are the only countries in the EU that have both a central database collecting odometer readings and, more importantly, a specific national legislative framework that regulates the matter[18].

The cooperation between Belgium and the Netherlands started in November 2016, following the signing of a declaration of intent by both organisations to have a joint approach to fighting odometer tampering. The declaration obliged the concerned agencies and organisations to mutually exchange data regarding vehicles that are traded between both countries in order to fight mileage rollback. This cooperation was further supported through a Memorandum of Understanding (MoU) signed between the Belgian SPF Mobilité et Transports[19] and the Dutch RDW, in order to arrange the exchange of odometer readings between Car-Pass vzw and RDW.

The two organisations chose the EUCARIS system as the ideal network to exchange data and information at cross-border level, since it represents an already existing framework at EU level for the exchange of information about vehicles registered in the signatory countries and driving licences.

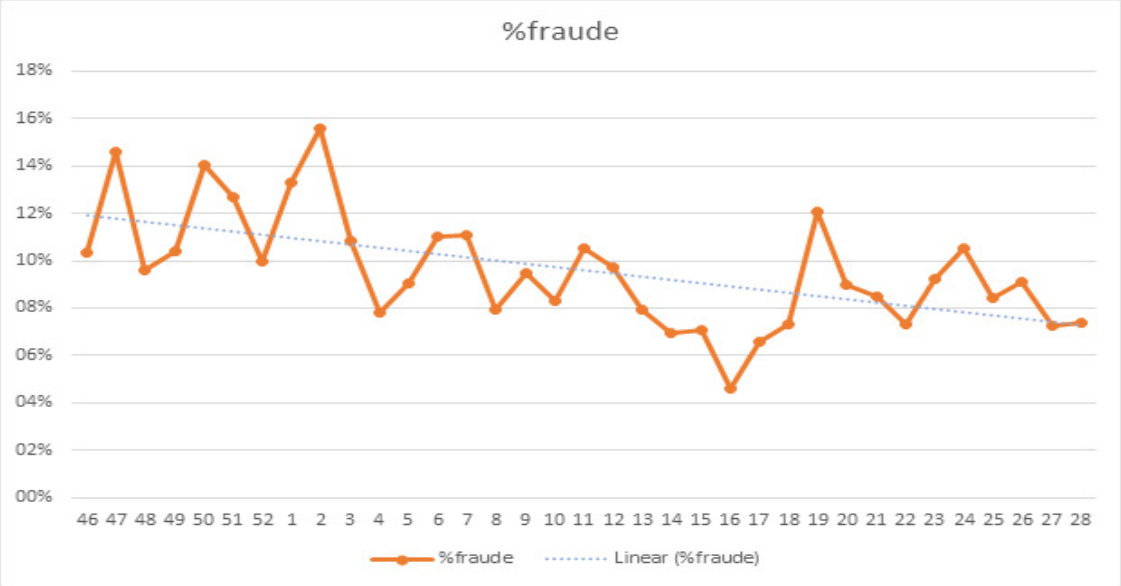
[18] Mileage information is also included in the registers of other EU Member States (e.g. Hungary, Luxembourg, Spain, Sweden, and Slovakia) (Ereg, 2014b). However, this is not accompanied by any specific legislative measures to tackle odometer tampering.

[19] The SPF Mobilité et Transports (in Dutch: Federale Overheidsdienst Mobiliteit en Vervoer) is the Belgian federal public service whose general mission is to prepare and implement the federal transport and mobility policy of the country.

Box 4: Data exchange between Belgium and the Netherlands

The data exchange has been structured as follows. Belgian technical inspectors verify that the odometer reading is compliant with the most recent mileage recorded in the Netherlands. If readings differ significantly, i.e. they are at least 5 000 km lower that the most recent mileage recorded in the Netherlands, it is assumed that the odometer has been manipulated. In the nine months considered – from November 2016 to mid-July 2017 – 6 248 cars and light commercial vehicles (LCVs) were imported into Belgium from the Netherlands, and in 596 cases (9.5%) it was assumed that odometer rollback had taken place. For the entire year 2015, when no data was exchanged between the two countries, it was estimated that on average 16.9% of imported vehicles were manipulated. Figure 7 below shows the evolution of the number of cases whereby odometer manipulations are very likely to have occurred. The weekly number – from the beginning of the project (November, week 46 in 2016) to the last available week (14 July, week 28 in 2017) – is shown on the X-axis, while the share of detected rollback cases calculated on the total imports per week is shown on the Y-axis.

Figure 7: Percentage of detected frauds on mileage readings of second-hand cars traded between Belgium and the Netherlands



Even though figures do not follow a linear trend, a decrease of odometer manipulation cases can clearly be observed. Estimated frauds amount to slightly above 10% at week 46 (peaking just below 16% on week 2 in 2017) and amount to less than 8% at week 28 (lowest point around 4.5% at week 16). The decreasing trend is even more consistent if estimated data of 2015 is taken into account, where approximately 20% of the odometers of vehicles imported from the Netherlands to Belgium turned out to have been tampered with.

Source: Car-Pass vzw (2017)

3.2. Best practices implemented outside the EU

Odometer tampering represents a serious issue in other parts of the world, too, and various actions are taken both by private organisations and by public authorities. Initiatives involving Vehicle History Reports (VHR) as implemented by the US Japanese and New Zealand bodies both for domestic and international sales are presented in this section.

3.2.1. United States

Odometer tampering is considered a crime in the US. The Federal Government passed a law, which concerns vehicles less than ten years old and requires that a seller provides a buyer a written disclosure of the odometer mileage when the ownership of a vehicle is transferred. If the odometer mileage is incorrect, the law requires that the seller prepares a statement to inform potential buyers that the figures displayed are not trustful (NHTSA, 2002).

The Department of Motor Vehicles (DMV), organised at state-level, is responsible for vehicle registration. Every DMV manages therefore the vehicle register, which includes the odometer readings.

The National Highway Traffic Safety Administration (NHTSA), a governmental office that is part of the US Department of Transportation, estimated in 2002 that odometer manipulation practices affected about 450 000 cars yearly, corresponding to an odometer tampering rate close to 3.5%. This entails an economic damage for US consumers close to USD 1 billion (or approx. EUR 832 million) annually by overestimating the value of used cars (NHTSA, 2002). According to a more recent Carfax's study[20] (Quora, 2015; Daily Mail, 2013) published in December 2013:

- Around 190 000 odometers of US cars are tampered with every year (compared to an annual volume of second-hand cars reaching 40 million units);
- The cost to consumers is more than USD 760 million (or approx. EUR 632 million in lost value and unexpected repairs;
- 53% of odometer rollbacks remove at least 50 000 miles (around 80 000 km) off the mileage.

The same source estimates that every year more than 89 000 vehicles with tampered odometers reach the Canadian marketplace – at a cost to Canadian citizens of more than USD 3.56 million (or approx. EUR 3 million).

The VHR provided by the private company Carfax contains all relevant information about a used vehicle's past[21]. Compared to Car-Pass vzw and RDW, Carfax collects a much wider range of information, covering the whole lifecycle of a vehicle and including odometer readings if available[22].

The Carfax service has also been extended to customers located in Europe and willing to import cars from North America. In 2009, Carfax launched the VHR service in Sweden and at that time, the number of used cars with mileage inconsistencies was around 300 000. According to Carfax, this number has been reduced to roughly 145 000 used cars in recent years (Carfax).

[20] Carfax is a commercial web-based service that supplies vehicle history reports to individuals and businesses on used cars and light trucks for American and Canadian consumers.

[21] Under the 1994, US Drivers Privacy Protection Act, personal information such as names, telephone numbers and addresses of current or previous owners are neither collected nor reported - http://www.accessreports.com/statutes/DPPA1.htm.

[22] Similar reports are provided also from other comparable private services, such as: AutoFax.org; EpicVin.com; VinAudit.com; MotoSnoop.com; VehicleHistory.com; AutoCheck.com; VINCheckPro.com; MyNRMA.com.au; Vinreport.io; VinDecoderz.com.

3.2.2. Japan

In Japan, cars have to be inspected every two years and part of the inspection is an odometer check. The odometer reading is recorded together with the owner's details. This watermarked document states the odometer reading of the vehicle at the time of the last two registrations before the export date. Random examinations of vehicles at imported car dealerships in countries without cross-checking processes showed that almost 75% had their odometer readings changed between the time they were purchased in Japan and the time they were advertised for sale (Japanesehistorycheck). Around 80% of cars from dealers have been found to have been rolled back between 50 000 and 150 000 km (Japaneseodometercheck).

Two main private agencies (Japan Export Vehicle Inspection Center, JEVIC, and Japan Odometer Check, JOC) operate in Japan. The first one offers its services for car importing countries and the second one is focused on the national market.

Established in 2001, JEVIC is the Japanese private company that regularly verifies odometer readings on inspected vehicles. Regulatory authorities of car importing countries contact JEVIC to conduct inspections on all vehicles prior to their import in their respective countries. The international branch network of JEVIC covers New Zealand, UK, Singapore, Trinidad and Tobago, Kenya and is currently extending its strategic alliances in the United Arab Emirates (UAE) and South Africa. It is up to the customer to decide whether to carry out such an inspection prior to the purchase of the imported vehicle, as there are no obligations prescribed by the law on this subject (JEVIC website).

Odometer checks are also undertaken by JOC, which provides official, watermarked registration documents with odometer readings certified by the Japanese Transport Authorities or the auction sheet containing information such as the auction grade, the sale price and the condition of the vehicle (Japanesecartrade).

3.2.3. New Zealand

According to New Zealand's Transport Agency[23], the average age of cars in New Zealand is in excess of 14 years. The age of the fleet has increased progressively over the last few years (it was 11.5 years in 2000) due to considerable numbers of second-hand cars imported from overseas, particularly from Japan. This practice makes New Zealand more vulnerable to potential malpractices linked to the history of the vehicles, including odometer tampering, and estimates on incidents of manipulations of imported vehicles from Japan range from 10% to 70%.

To combat this negative trend, New Zealand enforced its legislation[24] in 2008. In line with the new rules, all used vehicles have to display a Consumer Information Notice that includes a vehicle's odometer reading. The New Zealand Automobile Association (AA New Zealand) conducts odometer inspections of second-hand cars before they leave the port with its partner JEVIC. This inspection includes:

- removing and inspecting the odometer for any signs or evidence of tampering;

[23] The New Zealand's Transport Agency is a New Zealand Crown entity tasked with promoting safe and functional transport by land, including the responsibility for driver and vehicle licensing, investigating rail accidents and administering the New Zealand's state highway network.

[24] Notice Consumer Information Standards (Used Motor Vehicles) Regulations 2008 (SR 2008/112).

- examining all available service records to ensure they match the car's stated odometer reading;
- checking the car's history and comparing it to all other information about the car;
- checking the car's overall condition for signs of wear inconsistent with the odometer reading.

4. TECHNOLOGIES AVAILABLE TO ADDRESS THE ISSUE

KEY FINDINGS

- In recent years, **information technologies are being applied in more and more areas of** the **automotive industry**, including in the safety and security-related domains. However, **odometers** are still **inadequately protected against cyber-security threats**.
- The wide adoption of standardised common framework of reference for odometer tampering, the so-called "**Common Criteria**", **has been proposed as a potential technical solution** to be applied by the automotive industry to make odometer manipulations more difficult. However, the proposal was not welcomed by associations of car manufacturers.
- The **blockchain technology** would present interesting potentials to provide users with an effective fraud prevention system, **also increasing transparency and protecting privacy of data**.
- A wider application of **HSM and SHE-based solutions** could provide additional protection against odometer manipulations, protecting odometers from non-authorised access by way of secured chips.

4.1. Odometer security

Despite the fact that, for the past few decades, odometer readings have been shown in digital numbers and no longer in analogue format, manipulations still remain possible. Even more surprisingly, according to automotive sector experts, manipulations seem to have become easier than in the past thanks to specific tools that are able to reconfigure odometers in a few minutes. They are easily available on the internet at very affordable prices starting from about EUR 150.00.

These tools consist of small electronic boxes that are connected to the on-board diagnostics (OBD) port of the vehicles used by car dealers to run a diagnostic of a vehicle. Once connected, instructions provided by the tool allow their users to enter the mileage-recording system of the vehicle and to change the values simply by typing the desired number on the keyboard of the tool.

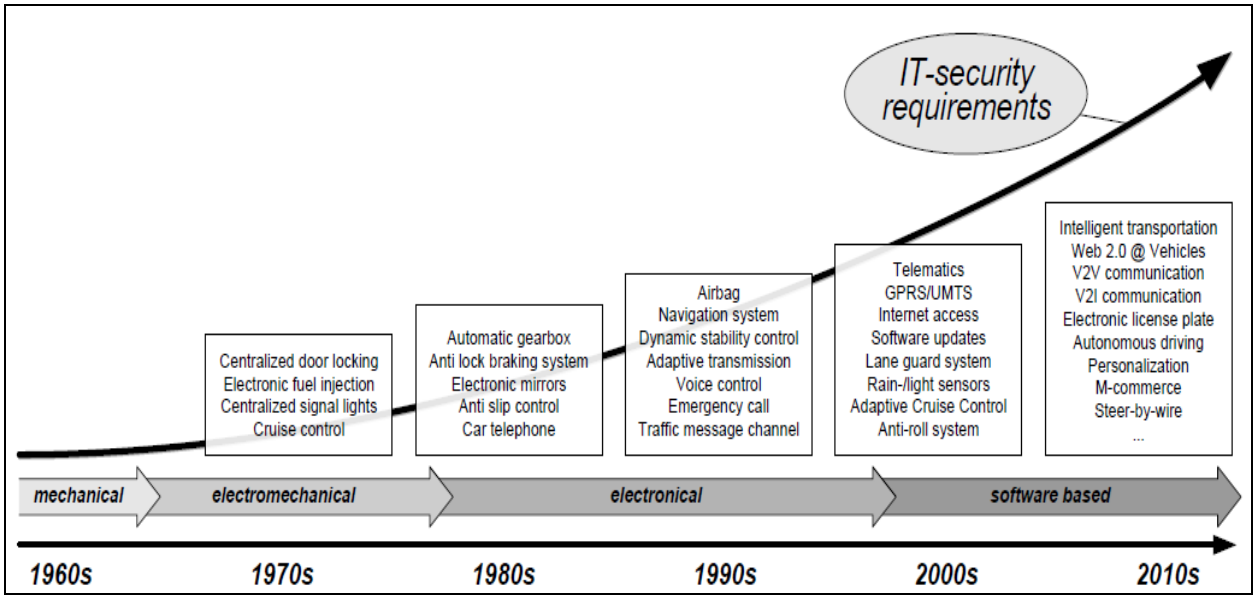
As confirmed by interviewees (FIA, CECRA, Car-Pass vzw), any manipulation is very difficult to detect and to prove once made, even by expert technicians using specific OBD testing devices. One of the most critical issues is that currently odometers are not locked out from external access, in contrast to other vehicle components, which have higher protection levels. As a result, odometers are not sufficiently cyber-secured and there is a need to identify one – or more – technical solutions that would prevent their tampering.

Potential solutions to be applied fall within the wide range of information technologies (IT). Many examples of IT-security applications are already being deployed in the automotive sector in relation to:

- theft protection;
- remote unlocking;

- keyless entry;
- vehicle tracking;
- Bluetooth and Wi-Fi;
- eCall;
- tolling;
- business models (e.g. license agreements, copyright protection);
- warranty: prove the origin of firmware;
- counterfeiting of components and spare parts; and
- Vehicle-to-Vehicle (V2V) communication.

Figure 8: The growing use of IT-security requirements in the automotive sector



Source: Weimerskirch A. (2012)

In line with regulations and legislative measures, IT technologies are expected to play an increasingly significant role in reducing and preventing attempts to tamper with odometers. Safety and security issues increasingly concern the entire automotive sector, as hacker attacks and manipulations can affect more components of a vehicle's architecture (diagnostics, engine, dashboard, entry system, etc.). Since vehicle electronics were first introduced, there has been a steady increase in demand for improving the security of microcontrollers in the automotive market. The vehicle-connected era is putting even more emphasis on security aspects as carmakers will have to build and execute solutions to protect their software from external attacks, and there will be a need for a certain standardisation.

Box 5 below examines in more depth the safety and security implications for the automotive sector as a whole.

Box 5: Safety and security in the automotive sector

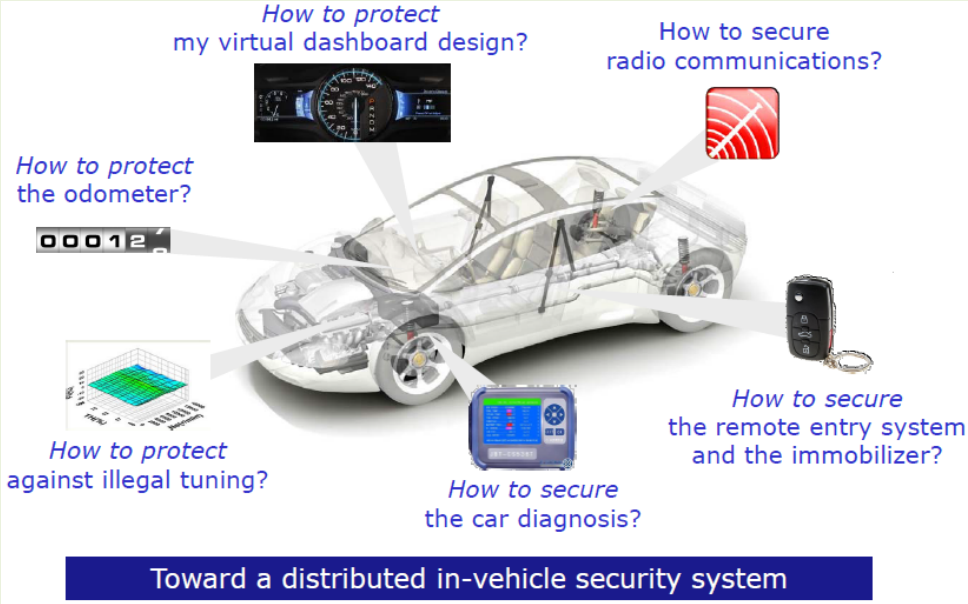
The increasing role of safety and security in the automotive sector

"*Already some people will tell you that a modern vehicle is like a computer on wheels*," said R. Wallace, director of transportation systems analysis at the Centre for Automotive Research in Ann Arbor, Michigan, (US)" (The Globe and Mail, 2016).

Electronic systems have become an increasingly large component of the cost of a vehicle, ranging from around 1% of its value in 1950 to around 30% in 2010 (Statista, 2017). Modern vehicles can now be equipped with a very high number of electronic control units (ECUs)[25]. The latest vehicles are equipped both with active safety features that help protect drivers and passengers, and with displays that make reading of instruments easy, as well as with in-vehicle infotainment that make car journeys more enjoyable. However, as vehicles become more and more automated and connected, security is of greater concern as vehicles become targets that are ever more attractive for hackers.

In today's vehicles, security concerns are linked not only to critical mechanical safety systems, but also to physical access and protection of confidential information. Vehicles are also expected to store increasing amounts of private information as they become "smarter". The increasingly interconnected nature of a vehicle's control modules means that safety and security issues are becoming more and more relevant.

Figure 9: Security-enabled automotive ECUs: the vision



Source: Devcon (2012)

[25] In the automotive industry, an ECU is an embedded electronic device, i.e. a digital computer that reads signals coming from sensors placed on various parts and in different components of the vehicle. Based on this information, the ECU controls vehicle's various important units such as the engine, as well as executes many other automated operations within the vehicle.

Over the past few years, the EU has financed several initiatives under its 7th Framework Programme for Research and Technological Development[26], which provided useful contributions to the European automotive industry. The **EVITA** project has developed a set of guidelines that detail the design, verification and prototyping of a range of security architectures for automotive ECUs[27]. EVITA defined the overall functionality of three different hardware security module approaches: full, medium and light. The follow-up **PRESERVE** project continued the work by developing, implementing and testing a scalable security subsystem for Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I). The PRESERVE project aimed at demonstrating the secure transmission of data and control information for the future intelligent transportation system (ITS).

Sources: Statista (2017); EVITA and PRESERVE project websites

4.2. Examples of available technologies

The experts interviewed in the course of the research highlighted a range of technologies that can prove useful to limit odometer tampering. Obviously, the overall target remains the same, i.e. if not to completely eradicate, then to at least limit manipulations as much as possible by creating higher technical barriers and thus making tampering more time-consuming and no longer lucrative for fraudsters. Technologies are also expected to keep track of potential manipulations in order to detect them with certainty each time a correction is being made, and in order to restore the real values.

The identified measures follow essentially three approaches. **The first one** is linked to the possibility of identifying a standardised common framework of reference for odometer tampering, based on international standards (ISO), which could be applied by all car manufacturers. **The second one** highlights the possible role of blockchain applications, while **the third approach** focuses on equipping a vehicle's ECUs and components with specific technical solutions that are developed and implemented separately by individual car manufacturers. In the following paragraphs, the identified solutions are described in more detail.

4.2.1. Standardised common framework of reference for odometer tampering

Odometer protection by means of adopting a standardised common framework of reference, the so-called "Common Criteria" (CC) certification, was proposed by FIA in the context of United Nations Economic Commission for Europe (UNECE) negotiating tables in 2015[28]. The CC is a common set of requirements developed over the years as an international standard (ISO/IEC 15408) by the Governments of several countries[29] to evaluate the IT security properties of a system or a product (Common Criteria website).

[26] The Framework Programmes for Research and Technological Development, also abbreviated FP1 to FP7 with "FP8" being named "Horizon 2020", are funding programmes created by the EU to support and foster research within the European Research Area (ERA). The specific objectives and actions vary between funding periods. The 7th Framework Programme was implemented between 2007 and 2013.

[27] A number of companies have been active in the EVITA project, including BMW, Continental, Fujitsu, Infineon and Bosch.

[28] The issue of odometer tampering has also raised attention in other international fora, particularly in the United Nations Economic Commission for Europe (UNECE) and its Working Party on General Safety Provisions (GRSG). The GRSG is the subsidiary body of the World Forum for Harmonisation of Vehicle Regulations (WP.29), which prepares regulatory proposals on general safety for WP.29, allowing open discussions on motor vehicle regulations. More specifically, FIA suggested the adoption of common criteria as a potential solution to combatting odometer tampering and proposed to install electronic vehicle interfaces such as on-board diagnostics (OBD) in all vehicles.

[29] The CC was developed by the Governments of Canada, France, Germany, the Netherlands, the UK, and the US in the 1990's.

The evaluation process is built in such a way so as to establish a "confidence level" at which it is agreed upon that a product or a system evaluated is compliant with security requirements set for the level of assurance selected.
The security concept is based on a protection profile[30] whose objective is to ensure that the mileage of a vehicle displayed to anybody interested in knowing the value (driver, buyer, seller, authority for inspection, etc.) is the correct one and results only from driving. Any inconsistency between the mileage shown in the dashboard and the value displayed in a secured place in an ECU of the vehicle should be visible in the dashboard (as a fault message, malfunction indication lamp, etc.).

The approach defines a single protection profile, but leaves the responsibility to car manufacturers to choose the appropriate protection for their vehicles by defining a security target based on the protection profile.

In 2017, 27 security institutions and agencies representing the countries from all over the world recognised the "CC" methodology (Common Criteria website)[31].

However, the position of the International Organisation of Motor Vehicle Manufacturers (OICA) on the complete standardisation approach of CC is not positive. More precisely, OICA considers the CC methodology to be cost ineffective and instead suggests following the recommendations of the CARS 2010 conferences. These recommendations include:

- a systematic recording of mileage at every PTI, servicing or repair centres. Such data should be collected and then consolidated at national level, by the organisations appointed for these tasks (e.g. State authorities for motor vehicles);
- an increase of PTI frequency, so that safety and environmental issues are also taken into account independently from the age of the vehicle;
- a promotion of cross-border data exchanges on odometer readings, in order to allow comparisons between different organisations responsible for collecting odometer readings.

Supporting the CARS 2010 overall approach, some experts interviewed (ACEA, Continental) for the purpose of this study pointed out yet another disadvantage of the CC approach. CC implies that certain types of products or systems are protected in the same way. This would mean that once a way to tamper with odometers is found, each vehicle of any carmaker becomes potentially vulnerable and can be easily manipulated in the same way. Individual solutions, adapted to the specific vehicle architecture of each carmaker, may offer additional protection, as they would prevent "standardised" tampering.

4.2.2. Blockchain technology

The application of blockchain technology[32] may represent another potential solution to be applied to combat odometer tampering, allowing for a more transparent access to

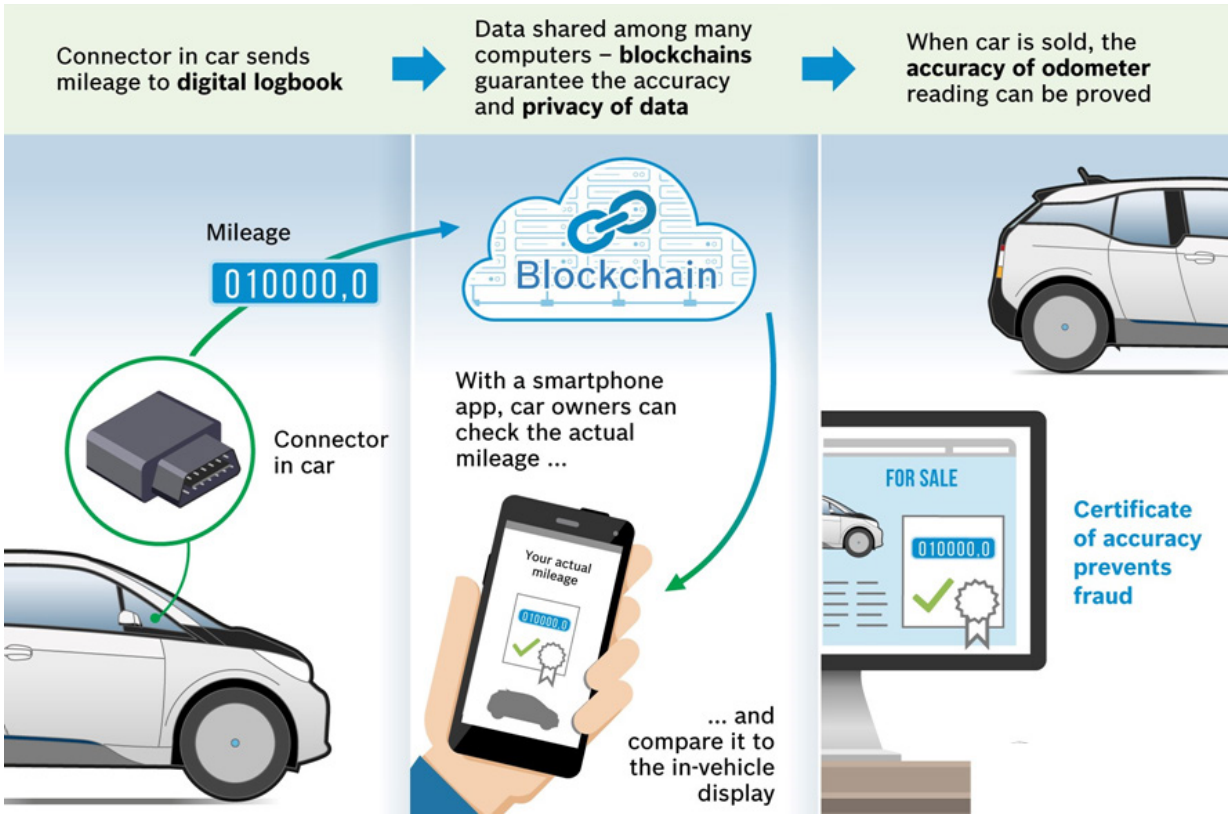
[30] A protection profile defines a set of security requirements, such as application-level firewall and intrusion detection systems, to be met for ensuring consumer IT security. Examples include: an application-level firewall or intrusion detection systems.
[31] The base for ISO/IEC 15408 and ISO/IEC 18045 is given publically under the Common Criteria website.
[32] Blockchain is a technology used for storing data. It is based on the principle of multiple databases linked as in a chain of data blocks, in contrast to a conventional database, where the data is saved on a single platform or server. The manipulation of blockchain data is therefore much more difficult as it would require to act on many different databases.

odometer figures and tackling two sensitive issues: privacy of data and frequency of data recordings.

Systems based on database recordings, such as Car-Pass, Carfax and similar ones, are sometimes criticised as they do not guarantee high-standard protection to the owner data (Chanson et al., 2017). This represents a serious barrier in countries where strict privacy laws are applied (e.g. Germany). Another drawback of this approach is that the time interval between mileage readings (i.e. between the registration of a new car and its first PTI or between two successive PTIs) can range to several years.

The blockchain technology currently proposed by the car engineering and electronics industry would allow downloading mileage and GPS data from vehicles, and securing it on a "digital logbook". Cryptography would provide users with a high level of protection, integrity and control of data. The frequency of data registration in the system can be modulated according to different needs and the information can be constantly validated with GPS data. Eventually, this technology would also ease data certification (Chanson et al., 2017) and could be supported by the development of connected cars concept where all relevant vehicle data could be accessed remotely.

Figure 10: The blockchain technology against odometer tampering



Source: Bosch (2017)

4.2.3. "Hardware Security Module" (HSM) and "Secure Hardware Extension" (SHE)

Advanced cryptographic technologies, such as Hardware Security Modules (HSM)[33] or Secure Hardware Extensions (SHE)[34], are already being fitted in vehicles, e.g. in the immobiliser systems which prevent access to the vehicle and also prevent starting the engine without the right car key. These systems contain high-value cryptographic keys that block non-authorised access, protect ECUs against manipulation and preserve the security and integrity of the systems.

As confirmed during the experts' interviews, each vehicle manufacturer has its own security systems installed in their vehicles. These systems are not necessarily based on the same architecture, parameters and levels of protection. The level of security can be substantially enhanced on the basis of software encryption, but the choice of technology is driven by the vehicle manufacturer. In this respect, technological solutions such as HSM and SHE, that allow secure communication between the system components involved by way of long cryptographic codes and secure key storage, could help protecting odometers from being manipulated. As an example, similar systems are used to secure e-ticketing or credit card chips.

In other words, the current technology for the protection of ECUs can be adapted to manage the security of the odometer protection. Practically, this can be achieved through a reinforcement of type approval legislation or voluntary commitment of the vehicle manufacturing industry to secure the mileage recordings.

A set of other IT and HSM-related solutions have also been suggested by the industry experts interviewed in the course of this research. They include primarily:

- **Storage of the odometer readings** in different ECUs or instrument clusters, so that if one of them is tampered with, the other ones can still show and restore the real correct mileage. In this way, the information can be retrieved at a later stage, for example when a trade takes place;
- **Installation of secure chips/semi-conductor facilities with stronger encryption**. These general information technologies consist of separate modules to be plugged into the device. Embedded systems in the vehicle contain all they need in themselves. According to FIA, nowadays many vehicles are already equipped with technology safeguarding security-related information (e.g. anti-theft or anti-tuning systems). The supplementary cost to secure the mileage recording is estimated to be about EUR 1.00 per vehicle by adding specific chips that protect the odometer architecture (FIA, 2014);
- **Theft-critical parts** – (e.g. replacement keys) should be sold only upon identification of the buyer and based on the proof of ownership of the car;
- **Installation of a new flashing software** - each time the vehicle's security system recognises an anonymous hacking attack, the light on the dashboard will flash.

[33] A Hardware Security Module (HSM) is a dedicated crypto processor that is specifically designed to protect critical systems, such as public key infrastructure, databases or web applications.

[34] A Secure Hardware Extension (SHE) constitutes a small hardware extension for adding essential security functionality to standard automotive microcontrollers.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

As discussed in the study, odometer tampering still remains a substantial issue in the EU. It is estimated that mileage rollback affects a significant share (up to 50% in some countries) of the total number of cars traded in the second-hand market and there is evidence that its scale is most prominent in cross-border trade of second-hand vehicles, where regulatory instruments adopted are less effective to tackle the malpractice. Existing EU legislation, described in section 2.3 of this study, sets general conditions that need to be met by the countries and the car manufactures to limit odometer tampering. At the same time, the EU legislation offers Member States necessary flexibility to take any additional actions at national level if they need to act more effectively. So far, only ten out of 28 Member States introduced supplementary measures and among these, Belgium and the Netherlands obtained the best results, managing to nearly eradicate odometer rollback.

The outcomes of both desk research and interviews carried out during the study confirm that a twofold approach is needed to achieve more satisfactory results in combating odometer tampering. The approach should focus on:

1. The implementation of stronger legislative measures at EU and national level, calling for stricter controls and mandatory recording of mileage readings when any kind of vehicle check occurs;
2. The application and diffusion of IT and technical solutions within the vehicle architecture to prevent manipulations or make them much more difficult and costly for fraudsters.

While the first approach mainly implies the intervention of the public sector (primarily the EU level and Governments), the second one calls on vehicle manufacturers to develop and implement more effective technical solutions to fight the phenomenon.

With respect to the legislative measures, Belgian and Dutch practices have shown the way to success in significantly lowering odometer tampering: in the domestic markets of the two countries the malpractice is now at a level of around 1% (or even less in Belgium) of second-hand vehicles traded. However, the effect of "Car-Pass" (Belgium) and NAP (the Netherlands) is limited when used cars are traded across borders. In this respect, the exchange of vehicle data for cross-border transactions established recently between the two countries, as well as between Slovakia and the Netherlands, is proving to be very effective and additional cases of odometer manipulations are being detected. Unfortunately, these positive effects are limited to the cooperating countries and their diffusion across the EU remains a challenge. The key factors deterring the progress in this field appear to consist in the different nature of legislation in the Member States, as well as in the way privacy information is being treated. Indeed, information about mileage readings is considered as sensitive and personal data in some Member States. In such a context, as also emphasised by the experts interviewed, measures applied at EU level would be the most effective ones.

On the theme of technical solutions, it is worth emphasising that odometers are not sufficiently secured and protected in the majority of vehicles sold worldwide. Manipulations can be made at a low cost and with no particular effort by mechanics and experts. Currently, no legislation prevents the sale of electronic odometer reprogramming tools,

which can be easily purchased on the internet. The identification of appropriate and effective technical solutions to ensure adequate protection of the vehicle's odometer clearly falls within the responsibility of vehicles manufacturers and vehicle component suppliers. The results of this research confirm that carmakers are keener on the development of their own IT solutions rather than on the adoption of a standardised approach to the identification of a common framework of reference (i.e. "Common Criteria"). The brand-new Regulation (EC) No 2017/1151 actually goes in this direction, stressing the role of vehicle manufacturers in improving the security of odometers, although its effects will be observed only in the years to come.

Rising importance of the connected cars' concept – and maybe in a not so distant future – of autonomous vehicles may enable a widespread deployment of various forms of the vehicle remote control. This may include the storage of all the vehicle's data in cloud-based datasets (following the principles of the blockchain technology), which could be accessed in real-time by users, car dealers and, if needed, motor vehicle agencies for inspections or standard checks. The increased transparency and accessibility of a vehicle's data might potentially contribute to the reduction of odometer manipulations.

5.2. Recommendations

Based on the previous considerations and findings, the following overall recommendations are put forward. The recommendations should be considered as mutually complementing rather than alternative stand-alone actions:

1. **Shortening of the maximum four-year period after which the first recording of the odometer readings is made**
   The EU "Roadworthiness Package", in particular Directive 2014/45/EC, requires mandatory recordings of mileage readings at any PTI and the collection of such data at national level. However, the maximum four-year time lapse between the registration of a new car and the first PTI is considered to be too long, as it leaves fraudsters a lot of time to tamper with odometers, especially on the newest cars with high mileage exploited in the first years. The first mandatory PTI after three years already adopted in some countries could be embraced at EU level. It is clear that such a measure, if taken in isolation, would have only a limited effect, as it would simply reduce the time interval in which the odometer manipulation could take place.

2. **Inclusion of additional measures within the EU legislation**
   An additional measure that might be included in the legislation is the requirement of mandatory (or at least recommended) registration of mileage not only at PTIs, but also at each maintenance and service. This is a key success factor for the initiative undertaken in Belgium. Considering that this data is often already recorded for maintenance planning purposes, the additional burden on operators might not be too heavy. In this respect, the future diffusion of the connected car concept would provide new and unexplored opportunities to monitor the odometer recordings. The possibility of exchanging the automatic mileage reading with carmakers, e.g. at fixed time intervals, could be a measure to be discussed with the automotive industry.

3. **Promotion of implementation of systems based on the national best practices**
   Member States should be encouraged to take stock of the successful experiences of other countries both from within (Car Pass vzw and RDW) and outside of the EU. Regulatory systems that have been implemented in Belgium and the Netherlands have proved to be very effective in tackling odometer tampering, since they contribute to the creation of a more transparent framework at national level, defining clear rules and responsibilities for all the stakeholders involved in the second-hand car market. These systems could be adapted to the specific markets and legislative frameworks in the various Member States. This is basically the path that Slovakia is following, since it started to collaborate with both Car-Pass vzw and RDW over the past years. Private-led initiatives, in particular the ones coming from the US and Japan, despite differing in both scope and extent from NAP and - even more - from "Car-Pass", proved to be valid alternatives. It is worth highlighting that US systems like Carfax are extending their services outside the North-American market, with a specific focus on the European market (e.g. Spain and Slovenia).

4. **Encouragement of data exchange between Member States on odometer readings**
   The share of tampered odometers is the largest in the second-hand vehicles that are traded across countries' borders. This is due to the lack of cooperation between the Members States. If such cooperation existed, the risks of buying a tampered vehicle could be significantly reduced. Here again, the experiences of Belgium and the Netherlands have proven to be effective. It is important to highlight that the existing EU-wide platforms (such as EUCARIS) could be used to facilitate the exchange of information between Member States on odometer readings avoiding duplications of databases and at the same time ensuring cost-effectiveness. Within the sector, a successful example is represented by Directive (EU) 2015/413 facilitating cross-border exchange of information on road-safety-related traffic offences. Since data protection rules are different among EU countries, this may entail the adaptation of some Member States' legislation in order to allow for the data exchange on a common platform.

5. **Monitoring the effectiveness of the provisions laid down in Regulation (EC) No 2017/1151**
   The EU legislation has recently seen the entry into force of the Type-approval Regulation (EC) No 2017/1151, which put stricter requirements on technology security for odometer recording equipment. The technology solutions adopted by car manufacturers and car component suppliers should guarantee that the objectives of the EU legislation are met and the right of EU consumers when buying a second-hand car (irrespective of the origin of the car) is safeguarded. The effectiveness of the technical solutions adopted should be evaluated in the years to come by setting up a dialogue with the industry and by monitoring the frequency reduction of the odometer tampering malpractice.

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- https://www.continental-corporation.com/en
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ANNEX A: LIST OF CONSULTED STAKEHOLDERS

NAME	ACRONYM	RANGE OF ACTIVITY
European Automobile Manufacturers' Association	ACEA	**Europe**
European Council for Motor Trades and Repairs	CECRA	**Europe**
International Motor Vehicle Inspection Committee	CITA	**International**
Fédération Internationale de l'Automobile	FIA	**International**
Association of European Vehicle and Driver Registration Authorities	EReg	**Europe**
Car-Pass vzw	-	**Belgium**
Dutch Government Road Transport Agency	RDW	**The Netherlands**
Cech predajcov a autoservisov SR	CPA SR	**Slovakia**
IRIS IDENT, s.r.o.	-	**Slovakia**

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