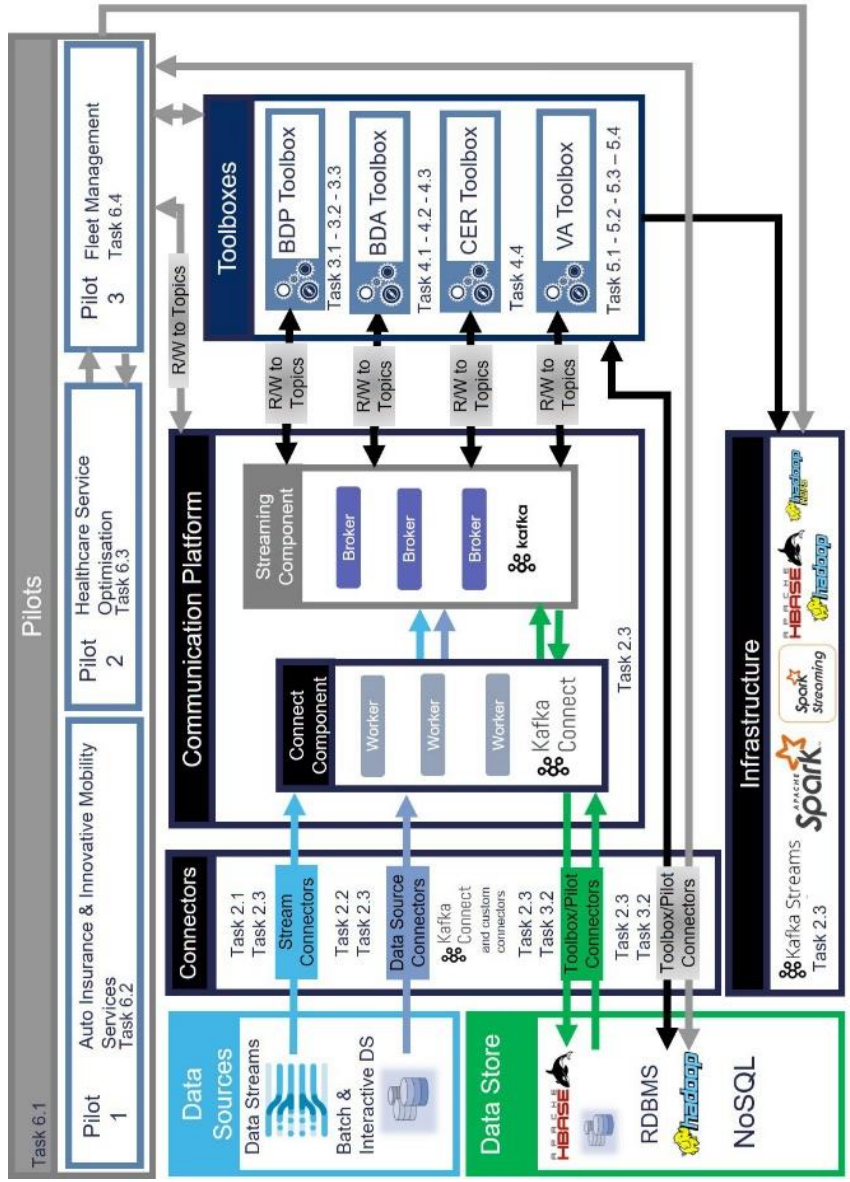
Track & Know

Track & Know (T&K) was a three-year (2018 - 2020) Horizon 2020 project. The project primarily focused on **mobility-based big data** and developed **innovative software stacks and toolboxes** that addressed key questions in emerging cross-sector markets such as commercial IoT services, car insurance and healthcare management.

Multidisciplinary research teams from Mobility Data management, Complex Event Recognition, Geospatial Modelling, Complex Network Analysis, Transportation Engineering and Visual Analytics as part of a T&K project consortium developed a new big data management platform and various toolboxes for processing and analysing mobility big data. Additionally, to demonstrate the applicability of the developed platform and toolboxes, the project also focused on resolving key business cases for 3 test pilots, namely transport/mobility, insurance and health care.

Big Mobility Data Integrator
(T&K Platform)

The Track & Know big data platform integrates online data streams, heterogeneous, contextual and archival data, that enable experts and stakeholders to advance their operational, processing and decision-making activities. The platform is a fully featured industrial grade solution.



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Toolboxes

Four toolboxes will be developed within the Track & Know project, which are core of the Big data platform and carry out a variety of different tasks. A **Big Data Processing (BDP) toolbox** is developed to implement data acquisition technology that captures data from heterogeneous data sources. The BDP toolbox extends the current solutions and delivers a tool for efficient access, indexing, partitioning and load balancing for Big spatiotemporal data.

The **Big Data Analytics (BDA) toolbox** is developed to analyse heterogeneous data and to draw conclusions about the spatiotemporal distribution of mobility patterns. The BDA toolbox delivers scalable data mining techniques (such as clustering, sequence mining, hot-spot analysis) for voluminous offline and online trajectory data.

A **Complex Event Recognition (CER) toolbox** (as part of BDA toolbox) detects complex event occurrences by analysing patterns in simple events. To do that, it uses contextual information and results from the BDA toolbox.

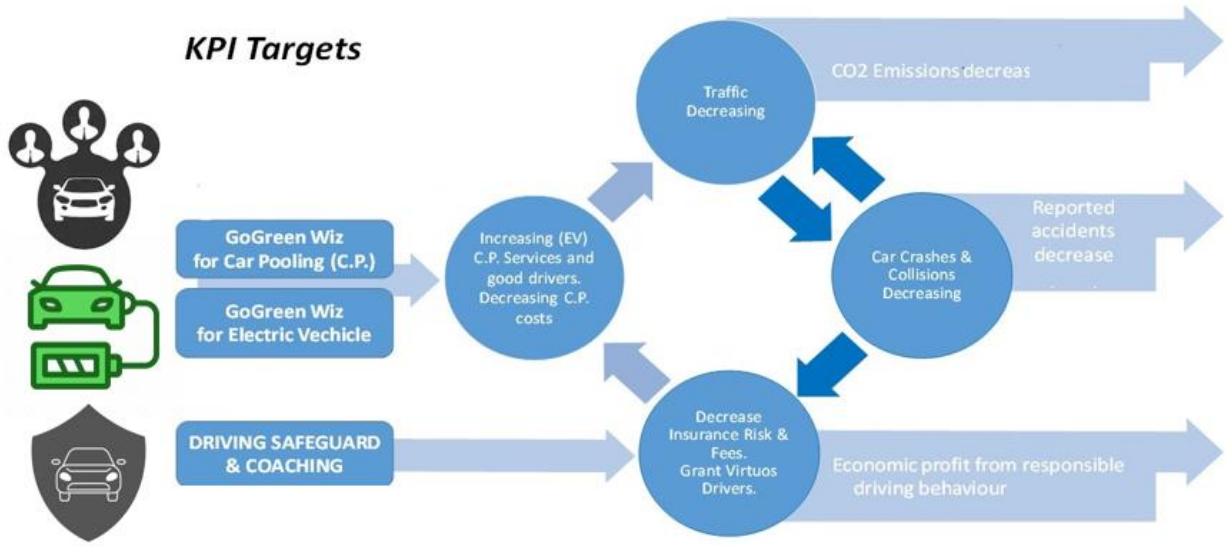
A **Visual Analytics (VA) toolbox** develops interactive and scalable methodologies to visualize data at all steps of the analysis.

Pilot cases and Track & Know tools

Pilot 1- Auto insurance & innovative mobility

In this pilot, T&K technologies and analysis methods are used to address **3 business questions** such as the Vehicle Insurance business case, Electric mobility and Car pooling/sharing business case.

The auto insurance business case, which has its premise in the idea 'Pay how you drive' led to analyse a research question about 'Will the driver have a crash in next month'? To answer this question, raw dataset from project partner Sistematica is used that contain GPS traces, events and crash information about drivers in a GDPR compliant way. This dataset is then processed through the T&K Big data processing toolbox, where data is cleansed, map matched and enriched with weather and point of interest information. Later, for the output dataset an individual mobility network (IMN) is developed using a T&K Big data analytic toolbox that provides a range of features of individual mobility. To answer a research question, a crash prediction model using machine learning technique was developed that correlated individual mobility and driving features to crash events. Overall tests (i.e. involving all areas together) confirm that the models perform particularly well on top-risky users. Based on the developed semantics, customers would be aware of their risk scores, and may try to improve it and therefore lower their insurance fee. More details on this pilot are available **on the project website** and in a video that demonstrates the pilot 1 analytic toolbox.



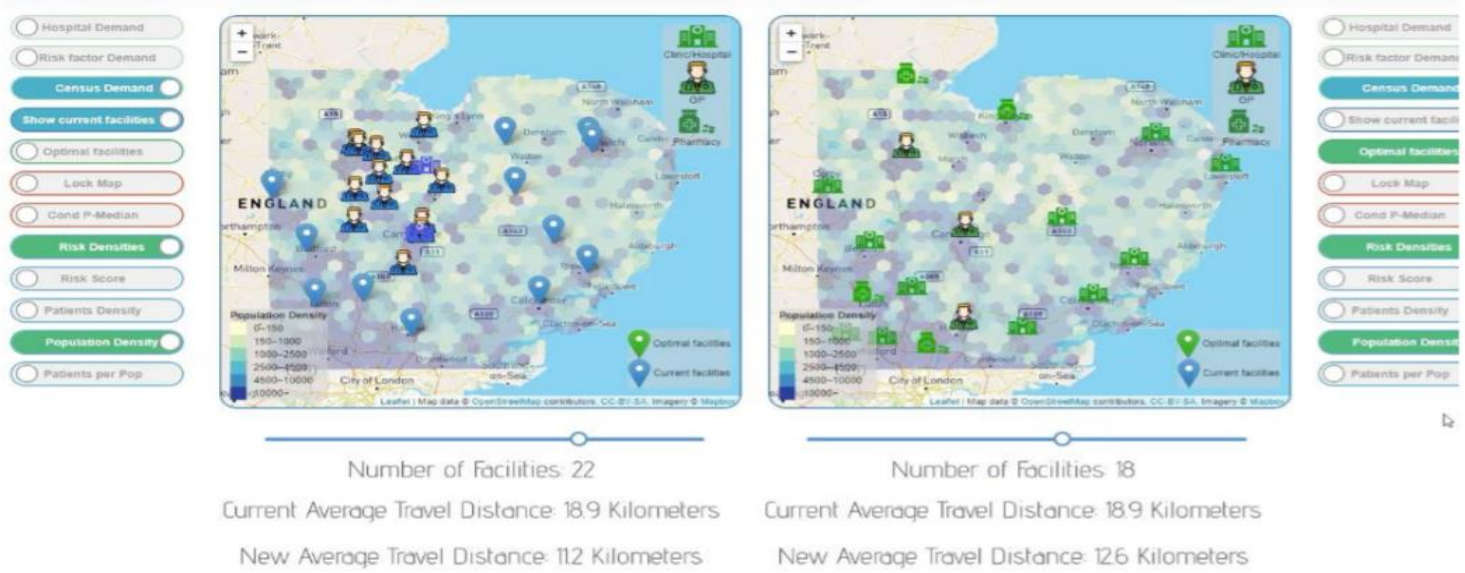
The 2nd business case in this pilot is related to determining the potential benefits (time and money) of switching towards electric mobility. The question analysed here is as follows: 'Given an individual customer with her mobility history, evaluate her costs or savings in terms of money and time in case of switching towards an electric vehicle (EV). T&K toolboxes, especially BDP and BDA, are used in a way that simulates a range of scenarios which reproduces the real mobility of an ICE vehicle user assuming to replace the car with an EV, thus counting its recharge needs and the costs in terms of trip deviations and charging times. More details on this are available **on the project website** and in a video that demonstrates the pilot 1 use of the VA toolbox.

The 3rd business case that has been resolved in this pilot is to obtain potential benefits (time and money) of switching towards car sharing/pooling. The question is very similar to what has been analysed in the 2nd business case. BDP and BDA toolboxes functionality is used again in a simulation manner, which assumes that the users considered are all willing to a carpool, so they are considered as potential drivers only along their easily predictable systematic trips, on which the service can infer without any declared users' schedule.

The trips of each test user are compared against the systematic trips of all the others to obtain: 1) how many trips can be covered by carpooling, 2) how much the time scheduling of trips needs to be changed to fit the drivers timing, 3) and how many different drivers the user needs to coordinate with. More details on this are available **on the project website** and in a video that demonstrates the pilot 1 use of the VA toolbox.

Pilot 2 – Health care

The Royal Papworth Hospital (PAP) provides the business domain for the health care pilot. PAP'S Respiratory Support and Sleep Centre is one of the largest Obstructive Sleep Apnoea (OSA) centres in the UK, covering an area of 200 sq miles (see figure on the left). Currently, PAP has over 12,000 OSA patients on treatment. There are 2 business cases: 1) Accessibility & Efficiency, 2) Patient driving safety. The complexity of the data analysis required to assess these 2 issues is beyond the capability of the hospital's IT systems.

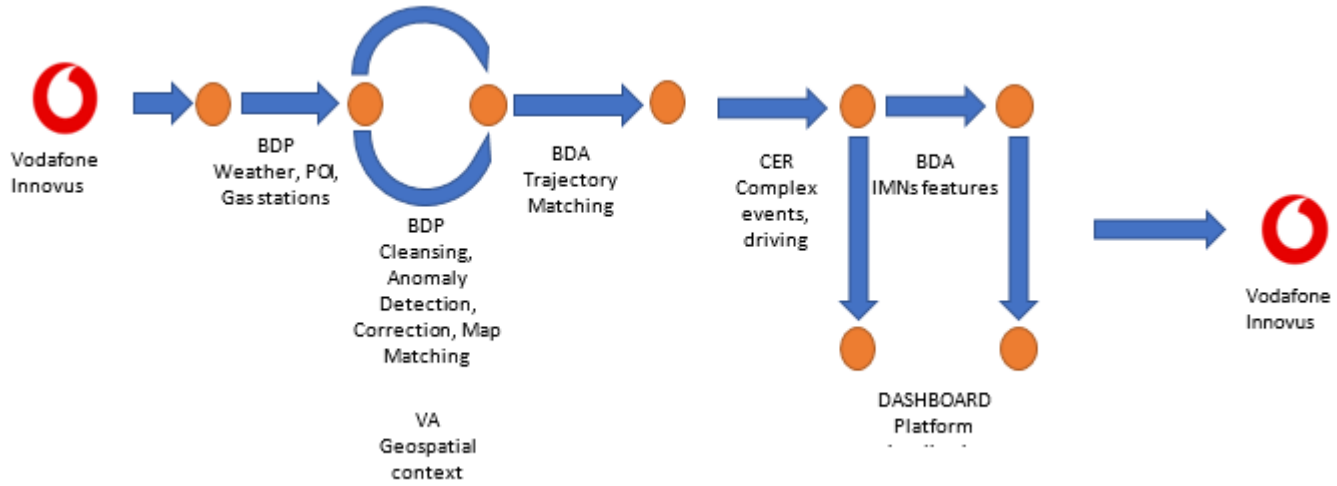


Numerous sub-questions on the above two issues are solved, demonstrating the new knowledge gained via the T&K platform and tools, which could not be gained with conventional analytics methods. Some examples are listed here: 1) Appointment travel analysis, in combination with visual analytics, weather enrichment, point of interest enrichment and complex event recognition has provided knowledge about attendance patterns across a large geographical area, possible reasons for 'No Shows' (especially concerning as the % is very high and rising further), areas of insufficient service deployment, potential third-party services that could be considered most effective for deployment etc.

2) The simulation tool for location / allocation – in context with the different demand maps created from appointment data, medical risk factor data and open data is unique and enables informed decision-making, depending on the priorities of the user, e.g. risk factor demand, population density demand, deprivation etc. 3) The driving traces of the test-subjects, acquired with an open-source app, combined with the weather and traffic enrichment to evaluate driving behaviour, as well as the individual mobility network tool to evaluate driving habits opens the doors to setting up valuable studies on driving in the population at risk of sleepiness at the wheel. More details can be obtained **on the project website** and in a demo video.

Pilot 3 - Vehicle Fleet Management

The enormous volume of mobility data in this new era thanks to on-board devices, sensors and wireless connectivity has posed new challenges in the world of mobility big data management. However, Track & Know's set of toolboxes, including Big Data Processing (BDP), Big Data Analytics (BDA), Complex Event Recognition (CER), Visual Analytics (VA) can enable the applications of big data to become opportunities to innovate the management and operation of fleet management systems. The use cases are focused on the data curation and filtering, enhanced with external sources like weather and POI, finding erroneous device installation, improving response time of the fleet in terms of platform, reducing the costs by providing realistic alternatives, predicting if possible the next maintenance task and improving existing driver behaviour classification. The pilot co-ordinator, Zelitron (ZEL) (now owned by Vodafone Innovus (VFI)) solved the uses cases by integrating the ZEL platform with the Track & Know platform and toolboxes. More details can be obtained **on the project website** and in a demo video.



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The analysis of the use cases helped identification of common routes for vehicles. Thus, reduce the number of vehicles on the road. Also finding hotspots (traffic points that vehicles are stopped or moving at slow speed) are marked as areas to be avoided contributes to the reduction of CO2 emission. The feedback from the stakeholders was positive, a few examples are:

- **Support Team (VFI):** Use of Complex Event Recognition to identify erroneous installation is a valuable error detection tool
- **Sales/ Product Owners:** Using forecasting, data cleaning, data analytics tools we differentiate from competition, new features that drive sales and enhancements with quality data'
- **Road Safety:** Using Driving Profiling helps educate drivers to better understand how their behaviour affects a vehicle's trajectory
- **Fleet Owners:** Tools like hot spot analytics, trajectory matching helps us reduce daily operational costs.

Track & Know Consortium

The Track & Know consortium is composed of 14 complementary partners, coming from addressed research, technological and commercial domains, that have a proven track record of high quality research capacity.

- Inlecom Group BVBA – Belgium
- Cambridge Medical Academy Ltd. – United Kingdom
- Consiglio Nazionale Delle Ricerche – Italy
- Fraunhofer Gesellschaft Zur Foerderung Der Angewandten Forschung E.V. – Germany
- Intrasoft International SA – Luxembourg
- Konnekt-able Technologies Limited – Ireland
- National Center for Scientific Research "Demokritos" – Greece
- NHS Royal Papworth Hospital – United Kingdom
- SISTEMATICA – Italy
- Universiteit Hasselt – Belgium
- Sorbonne Universite – France
- University of Piraeus Research Center – Greece
- Universitaet Zuerich – Switzerland
- Vodafone Innovus - Greece

Find out more

If you are interested in the Track & Know project, please visit the project website or social media.

- www.trackandknowproject.eu
- Twitter: @TrackandKnow
- LinkedIn: Track & Know
- YouTube: Track & Know project
- Researchgate

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Big Data for Mobility Tracking Knowledge Extraction in Urban Areas