Sleep Well - Drive Safely
A Tale of Mobility Tracking and Big Data

In a small medieval town called Cambridge, there lives a good doctor, known as Mr. Sandman. He spends all his day helping people have a healthy night sleep. He does that by finding out who suffers from bad sleep and dishing out special face masks to give people nice dreams and wake up rested in the morning.

That is why many other doctors from the entire kingdom of Cambridgeshire send patients to him to be checked up. Knowing that this treatment decreases his patients' risk of death from illness or traffic accidents, Mr. Sandman has put all his energy into serving the needy people. However, over the last decade the number of people afflicted with the condition has steadily grown - as the kingdom has become wealthier, the ongoing feasts have led to overeating, poor health and bad sleep.

To meet the increased demand, Mr. Sandman expanded his service by setting up 21 additional clinics. This made it more convenient for patients from all corners of the kingdom, to come and pick up their test kit, take it home to measure their sleep overnight and then bring it back to the clinic the next day for checkup and assessment. This way Mr. Sandman's service was able to serve 10 000 patients each year.

Still, this was not enough, and it was estimated that the service only reached half of the patients in need of treatment. There were many sufferers in various corners of the kingdom who could not be reached. Some of those who could be reached, had to wait a long time or travel a long distance to get to clinics. This was of great concern, as there would have been less illness or driving accidents in the kingdom, had the sleep sufferers been checked and treated on time.

To make things worse for the service, up to a fifth of the sufferers booked for appointments would not turn up, thus not only endangering their health but also wasting precious resource for others who had been waiting for help.

The deployment of a new information system at the service did not provide solutions to resolve the problem. It was impossible to oversee the allocation of patients to clinics and test kits, the distances travelled, the gaps in geographical coverage as well as the reasons for non-attendance.

New approaches and solutions were required, that would put all patients, doctors, clinics and test kits into the right place, so that service could be provided where and when it was most needed. Notably, Madam CCG, the treasurer of the kingdom demanded that the service provision had to cover the needs with the same available resource, so clearly a smart approach to service optimization was needed.

So, Mr. Sandman sent out all the king's horses and all the king's men to the Horizon, to find the best architects for a smart analytical toolbox that could interpret large numbers of different data from various sources and build optimization scenarios. Interestingly, two other trades in other kingdoms had similar needs for efficiency gains in their businesses. It happened that the three trades – health, rental cars and car insurances joined forces in the quest for a magic toolbox, which would gather knowledge of whereabouts, events and timings and mix it with lots of other information in a new way to provide much clearer business information and improve decision making and efficiency. This was the beginning of the Track&Know project, which united researchers and technology developers to build a smart Big data toolbox for efficiency gains of mobility tracking and test it in three pilot domains.

It did not really matter that Mr. Sandman's data did not quite have the levels of sophistication of the other two pilots. The health pilot's data were more medieval and needed some modernization in order to benefit from the tools. To bridge this, the historical data from Mr. Sandman's clinics were converted to mobility data and the reconstructed travel trajectories were fitted in the toolbox for further enrichment (incl. Points of Interest, Weather, Traffic), clustering and hot-spot analysis, and map matching and trajectory prediction.

As a next step, the other tradesmen kindly lent Mr. Sandman some of their real-time mobility tracking tools, in order to collect travel and behavior information that would aid the understanding of the mobility issues impacting on the service.

As a result, the toolbox will allow to improve the efficiency of Mr. Sandman's sleep service, position the clinics as well as test kits according to the needs, decrease travel distances for patients and improve access, as well as reduce the appointments wasted because of No Shows.

But wait, there is more. This is not where the story ends, as it is not just about innovative technology development but also an example of cross-pilot collaboration and cross-fertilization of results.
The T&K toolbox was already planning to use the mobility tracking in the rental car and car insurance pilots to also extract risky driving profiles. During the project a new opportunity to add value by BD tools was seized. Mr. Sandman proposed that the mobility tracking tools lent to his service by the other pilots could derive driving patterns typical of sleepiness on the wheel. Such research has not been conducted before. Mr. Sandman has already lined up a large number of sleep-deprived patients, as well as shift-workers, who are ready to be tracked during driving. On these driving data that will be collected via the other pilots' mobility tracking tools, the T&K toolbox will apply the driving profiling technologies developed for the other pilots in order to extract patterns that might occur in sleepy drivers. The potential impact on road safety is significant. At the same time such a tool would help avoid unnecessary restrictions on drivers who are not at risk and monitor drivers who need OSA treatment for compliance. Over a longer timescale, the identification of sleepy driving profiles could also lead to the development of warning alarms in the vehicles.

One important lesson has been learned from the health pilot implementation. The Big data value will increase if technology developers work closely with end users to define their current needs and to brainstorm how to add value in areas previously not deemed as possible to tackle.

Please take a moment to hear what the end-users and stakeholders in our story had to say about the expected results:

Mr. Sandman (aka Dr. Ian Smith, Director of Sleep Services at RPH): "The results of this health service pilot will not only have an impact on improving the efficiency of our service, but they would also motivate a nationwide review of sleep disorder testing service provision. Considering the increasing worldwide burden of OSA, advances with this approach would be a showcase for facility siting practices at the international level as well."

Madam CCG*: "The outcomes of this study will provide data and information to inform better service commissioning, ensuring patients are seen effectively".

SATA** representative: "As a committee member of SATA I can see great benefits for patients and suspected patients".

Patient organization representative invited to the study: "As a patient, if this improves my safety and the others' safety, then it is almost a no-brainer to decide."

OSA*** partnership group: "The driving profiling approach using the tracking app is very interesting and promising to improve driving safety. So far, we had no useful solution to monitor sleepy drivers, a dashboard camera was thought to be too invasive."

*Clinical Commissioning Group
**Sleep Apnoea Trust Association
*** Obstructive Sleep Apnoea

This is not The End yet
https://trackandknowproject.eu