Innovate UK

INNOVATE UK 'FIRST OF A KIND' (FOAK) - CITI LOGIK LIMITED CITIWATCH PROJECT FINAL REPORT – EXECUTIVE SUMMARY

citi logik
making sense of cities

"CitiWatch - The World's First Traffic Planning System Using Real-time Mobile Network Data"

CitiWatch
Understanding Urban Living

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Date: 29 March 2018

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E1. Executive Summary

On 24th March 2018 as the Citi Logik team were preparing the final report on CitiWatch, a real time platform analysing movement by vehicle on foot and by public transport using the existing 3/4G network, the Daily Mail reported that '*the latest Department for Transport data reveals an average speed for cars on roads in urban areas has dropped to just 18.4mph. The RAC is suggesting that extra investment is needed to reduce congestion and to optimise traffic flows'*.

These observations reinforce the conclusions of a recent DfT commissioned report, which cited the lack of data gathering techniques was identified as a major inhibitor to change[1] in deriving transport benefits from Big Data and the Internet of Things (IoT) in Smart Cities. In summary, to address this shortfall, Citi Logik has built the *CitiWatch* Platform for mid-tier city, local government customers who have traditionally had limited access to real-time services to support their decision-making, transport operators and citizens who increasingly want to learn more about urban living and the environments in which they live and work.

E2. CitiWatch Solution - A Response to the Voice of the Customer

CitiWatch core functionality was built based on 'Voice of the Customer' feedback gained during the Transport for London proof of concept demonstrator in 2012, which was focused on: assisting city or transport operators to detect trends leading up to incidents especially on corridors, early warning and alerting systems and analyses multi-modal movements across the target city, port, or region. This learning were reinforced during the period September 2017- March 2018 through a programme of validation events with target customers: Telegraph Digital Enterprise Network; Transport Modellers Forum; Local Government Strategy Conference; BIN@Sheffield2017; DIT 'Smart Cities' Trade Mission to Ireland; SmartCity World Congress in Barcelona; European Transport Conference; InnovateUK delegation to Australia; and the Pathfinder Multi-sector Trade Delegation to Kuwait.

Citi Logik also surveyed attendees, with the organisers, at the Local Government Strategy Forum on 7-8th November 2017 and were able to affirm from an audience of 150 senior local government decision makers, the level of delegate 'investment interest' in the areas shown in this table:

Digital Transformation	47%
Business Intelligence	37%
Data & Information Management	29%
Joined up Data	25%
Big Data Analytics	22%
GDPR	22%
Predictive Analytics	18%

The Company concludes that the original FOAK submission premise of digital transformation through business intelligence by joining up a GDPR compliant Platform with the use of predictive analytics is entirely valid as originally stated: "Real Time analysis is critical to understanding the challenges of congestion, modal shift, targeting intervention and finding capacity in the local network". In short, there is market demand for CitiWatch.

E2.1 CitiWatch the Platform. The FOAK grant monies were secured in April 2017 to build CitiWatch, the world's first Traffic information system driven by anonymised mobile network data. CitiWatch is a scalable commercial off the shelf analytics engine for the analysis of vehicle, pedestrian and public transport journey paths compliant with ICO guidelines and EU privacy laws (GDPR). The real-time platform can display travel demands, speeds, congestion, network flows and Journey Time Reliability. It has been built, tested and deployed to aid understanding of urban environments through real time analytics, comparative analysis versus baseline conditions and predictive analysis using network analysis, artificial intelligence and deep data mining. The platform comprises a cloud based multi tenancy platform; provision of 3/4G network data in real time; corridor monitoring of local road network; and a prediction engine for deteriorating traffic conditions.

[1] Ricardo Energy and Environment: "Scoping Study into Deriving Transport Benefits from Big Data and the Internet of Things in Smart Cities." Final Report for Department for Transport (Contract No. CCZZ16A22) June 2017 https://www.gov.uk/government/publications/transport-benefits-from-big-data-and-the-internet-of-things-in-smart-cities

E3. Implementing Transport Technology as an Enabler
A challenge Citi Logik has faced during this project was the need to demonstrate real-time capability to deliver a fully functioning Data as a Service (DaaS) without having a large R&D budget. The trial site customers were similarly challenged with having a need for real-time analysis but with no R&D budget. Understandably the client team were unable to fund-real time without the full proof of value and field deployment supported by Innovate UK FOAK. One of the initial trials for this FOAK project was undertaken by *Worcestershire County Council* (WCC) with the support of the transport operations teams who allocated staff time to assist with deployment, assessment and feedback. The Head of Strategic Infrastructure at Worcestershire County Council confirmed that Real Time analysis is critical to understanding the challenges of congestion, modal shift, targeting intervention and finding capacity in the local network.

E3.1 Building CitiWatch. The technical build was undertaken by a strengthened Citi Logik technical team supported by Vodafone telecoms capabilities; a combination of development effort, data feed enablement, trial, and exploitation effort. The CitiWatch platform was built in a modular format comprising:

- Authentication layers controlling user access to applications and services configurable based on their needs;
- Visual interfaces to analytics/database engines for real-time and non-real-time data and reports;
- Support to multiple external APIs to interface with mobile network operator systems traditional sensors and new data sources.

The CitiWatch portal specification has been designed and built to provide a web interface, which allows the user to view and interact with the platform through both GIS (mapping) and graphical dashboards where the user can interrogate transport mode patterns and the network performance of a given point or area. The portal has a fully interactive geospatial (map centric) interface that allows the navigation and selected functions to be used. During the build, the key technical challenge related to building drill down functionality for a wide area. In addition, data speed rendering issues needed to be addressed during the design phase to maintain a positive user experience. A key element of the build phase was to link raw anonymised data from the telecommunications network in real-time with the newly built cloud-based processing engine capable of handling up to 100,000 events per second. The now pre-processed real-time could then be analysed using proven analytics techniques including ‘snap to road’, ‘snap to rail’, ‘snap to area’ which had been transitioned from historic data analysis.

E3.2 Traffic Prediction Modelling. During this FOAK contract the Citi Logik Analytics team developed a short-term predictor based on two key features: a journey generation algorithm for identifying traffic flows along corridors; and an expansion algorithm which transforms MND traffic flows to actual journey times and traffic volumes. The algorithms, together with the predictor, have been implemented and visualised in CitiWatch based exclusively on MND.

- Corridor based information on journey time, traffic volume and RAG (Red/Amber/Green) against normally expected traffic conditions;
- Point-of-interest information on journey time, traffic volume and RAG against normally expected traffic conditions; and
- Predictions of the above and expected RAGs in the predicted timeslot.

E3.3 End to end Journey Analysis. The Citi Logik team have developed a series of algorithms and analytics techniques to understand anonymised network data, which were previously built from learnings on 15 major transport projects completed in period 2015-2016. The Analytics Development phase created the data processing algorithms, data flow charts, technical guides, user guides and calibration notes. The Journey Generator which now receives raw events (billions per day), collating all the events per device and then building all of these into individual device journeys in real time. The challenge which was overcome was to be able to process the events in real-time, with peak data arriving achieving up to 100,000 events per second. Operating in real time utilising existing algorithms and processes to create Road Performance Metrics of the road network. The output is then compared against a historical performance profile from the non-real-time analytics engine output to produce detailed road attributes for each selected segment. During the build of these components the challenges overcome were generating the resultant road performance metrics against the historical baseline in a timely manner and automating key network segmentation.

E3.4 Data as a Service (DaaS). Access to the data services was also addressed via API to allow remote access to specific processed data. This interface allows clients who have already invested in other

technology to be able to integrate CitiWatch services into their existing investment. It was the assessment of the design team that the ability to integrate DaaS within existing systems to reduce barriers to a broad adoption of CitiWatch data, into existing transport operations or other platforms.

E3.4 Test & Evaluation During the Test and Evaluation supported by QinetiQ, the team identified CitiWatch as impactful: "with its near real-time information updates on journey time, traffic volume and traffic speed, it is an ideal candidate to use new technology to help improve the transport network, and thus also the local economy, environment and quality of life of its residents." Using benefits mapping techniques to identify measurable goals and objectives, the report found that comparison of the baseline metrics derived from observing current operations and the changes (once CitiWatch was deployed) allowed the following benefits to be quantified by QinetiQ: Improve Economy 22.4%, Improve Environment 30.2%, Improve Well-Being 9.3%, Safety 22.7%.[2]

E4. Learnings from the CitiWatch FOAK Project

"Transport technology" is explicitly cited by WCC (and many other) local authorities as a key enabler for meeting their strategic organisational objectives by managing demand on the network, tackling congestion, improving road safety and supporting growth. An important by-product in developing CitiWatch has been that the Citi Logik team has developed a better understanding of where the actionable data delivered and visualised through the Platform can have an impact on both the operational and strategic connected transport objectives of local authority end-users.

E4.1 Robust Programme Management. CitiWatch was built using best of breed project control and project management principles within a PRINCE2 methodology which covered: initiating the CitiWatch project; directing the project; controlling the build stage; managing stage boundaries; managing platform delivery; finally, the field trials and execution phases, including the field trial assessment methodology. The building blocks of CitiWatch were constructed by: i) on-going and constant engagement with our stakeholders throughout the project life cycle; ii) collaborative work with Vodafone, QinetiQ, taking a "one team" approach; iii) constant communication with regards to all project related tasks and risks; iv) focus on management of change and risk; and v) continuous review processes to establish project status and milestone delivery. By the end of October 2017, the CitiWatch core capability was deployed into the test environments where it was calibrated and tested against the pre-agreed customer use cases at TRL 6.

E4.2 Critical Communications. The Citi Logik team learned that the benefits of taking a 'flexible implementation' approach to project planning and would recommend this methodology to other project management teams. Another recommendation would be to consider fully the communications mechanism that will be required to progress the project to a successful conclusion at the outset. Specifically, for the Citi Logik team these communication points were salient:

- Virtual Communications can bring great advantages both in terms of cost and time to any project but on complex builds like CitiWatch face-to-face meetings play an important role;
- Managing client expectations is essential on a project which is dealing with matters not been tried or done before. FOAK needs extra communications with end users and stakeholders;
- Customer Feedback Drives Development. As a corollary to this, trapping client feedback and making sure that issues and requests help drive development is essential;
- Improved Relationships with Suppliers. This FOAK project meant we focused on a common objective with key suppliers, which improved our commercial relationship.

E4.3 Risk Management. The Citi Logik team drew on prior learnings from already deployed historic analysis data for transport planning including projects at London Heathrow, Gatwick and in South Wales with leading consulting engineering firms. From this, the assessment was that CitiWatch was a medium risk programme and the Citi Logik team had a clear risk mitigation strategy based on our proven track record of facing similar challenges with non-real-time data. The risk register profile was therefore particularly focused on the handling of real-time data volumes, real-time modal analysis and real-time validation techniques. A key consideration for the Citi Logik team was also to build a scalable architecture and to develop a team structure capable of analysing deploying the platform and then realising the full benefits, within a multi tenancy real environment, which can then be deployed both in the UK and internationally.

[2] CitiWatchFOAK – Benefits Evaluation and TRL Assessment. DO2: Final Report. Andrew Barwell. QinetiQ/17/03641 March 2018

E5. Sharing the Benefits of CitiWatch

Once the CitiWatch platform capability was established in Worcester, QinetiQ worked with end-users to define suitable metrics, to collect and analyse suitable data, and to report on the realisable benefits using mapping techniques to identify measurable goals and objectives. Because of core observations from the Worcester CitiWatch deployment, and the findings of the Test & Evaluation report, the Citi Logik team were able to assess the impact of *future* deployments of the CitiWatch platform comparing Local Authority Strategic objectives to Operational Objectives, the following assessment of the impact of *future* deployments of the CitiWatch Platform on connected transport policies is postulated.

CITIWATCH LOCAL AUTHORITIES CONNECTED TRANSPORT IMPACT ASSESSMENT TABLE

Local Authorities Strategic Objectives

Local Authorities Operational Objectives	Improve Economy	Improve Environment	Improve Well-Being	Improve Safety
Comparative Analytics	HIGH	HIGH	MEDIUM	MEDIUM
Transport Operations	HIGH	HIGH	MEDIUM	HIGH
Incident Management	MEDIUM	LOW	MEDIUM	MEDIUM
End-to-End Journeys	HIGH	HIGH	HIGH	MEDIUM

HIGH IMPACT - Where there is a CLEAR linkage and improvement from deploying CitiWatch in baseline risk assessment to strategic objectives e.g. CitiWatch delivers actionable data to improve end-to-end journey times which, in turn, has favourable consequences for the local economy

MEDIUM IMPACT - Where CitiWatch deployment MODERATELY improves understanding of operational environment through actionable data and there is a noticeable , positive, affect of this on Local Authorities strategic objectives

LOW IMPACT - Where CitiWatch adds LITTLE VALUE to affecting the operational objectives and, consequently, has little or no affect on improvements in strategic objectives

E5.1 CitiWatch Commercialisation. Following the initial project with Worcestershire County Council and Peel Ports, we expect to have a CitiWatch Platform product that we can sell to other cities and transport hubs in the UK from 1st April 2018 and internationally from 1st June 2018. From this point onwards, the CitiWatch Platform can be defined as being the provision of an *Analytics as a Service* (AaaS) which would be self-funding through sales revenue and long-term loans whilst retaining its DaaS capabilities through APIs for clients who are locked into other proprietary portals.

An important part of the 'market assessment parallel processing' inside Citi Logik that went along with the CitiWatch FOAK technical project timeline was the development of a business model which will power the Platform's commercial exploitation. This business model needed to cater not only for sales into sites like those where CitiWatch was being tested under the FOAK 'Connected Transport Challenge', a mid-tier UK city/county and a northern British port, but also other contexts such as clients whose projects emanate from the Internet of Things, Smart Cities, Urban Living and Big Data initiatives.

E6. Summary

CitiWatch is set to become a 'disruptive' substitution for existing legacy techniques in a highly fragmented market comprising roadside surveys, induction loops, SCOOT, CCTV, Wi-Fi, and Bluetooth counts. It is also a disruptive replacement for small sample GPS derived analytics technologies, given the ubiquitous nature of the mobile phone and the hugely greater data streams arising.

Citi Logik has put British ingenuity in MND Location Insights 'on the map' and has created a powerful story, which resonates with potential customers around the world. The Citi Logik team know this because we have pitched CitiWatch and its capabilities weekly and have won business from Copenhagen to Melbourne. Mobile phones form the biggest, most comprehensive IoT network everywhere and anywhere. The lessons we have learned from CitiWatch FOAK make our growing UK Company a global leader in the field of Location Analytics.