BLUE DOT TAXI SYSTEM IN THE WESTERN CAPE: SYSTEMS AND TECHNOLOGY OVERVIEW

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ABSTRACT

The Western Cape Department of Transport and Public Works (DTPW) initiated the Blue Dot Taxi pilot project to encourage, monitor, and reward behaviour change in the minibus taxi (MBT) industry through an incentive programme for compliant participants. The incentive is determined by the participant's performance against specified standards designed to improve road safety and service quality for passengers and the broader public. To enable this, each participating taxi is fitted with hardware, including a telematics device and a driver tag. This hardware links the taxi and driver to the incentive system, which routinely checks that compliance requirements have been met and measures performance of the participants against the standards. Participants are enrolled via a registration portal, and their vehicles are inspected using a purpose-built depot application. Compliance checks include daily eNatis and operating licence validity checks, amongst others. All this information feeds into the Intelligent Transport Solution, which monitors and measures performance through a Business Intelligence platform, and calculates incentive payments. Passengers can also rate taxis via WhatsApp and USSD and report incidents, which automatically impacts the incentive calculation and improves accountability of participating MBT services. The government-owned technology is easily scalable and has been successfully used to reduce instances of speeding and harsh driving, and improve passenger perception.

1.   INTRODUCTION (AIM, SCOPE & PUBLIC TRANSPORT OVERVIEW)

Within the Cape Town, the predominant modes of public transport are minibus taxi (MBT), rail, legacy bus, and bus rapid transit. The sector is highly fragmented and limited by spatial challenges such as low densities, a strong private car culture, and high peak to base ratios. Additionally, there are low-income levels among majority of public transport users.

MBTs provide over 70% of public transport trips for workers in WC (NHTS 2020), servicing around 1 million daily passengers (NHTS 2020). However, the industry faces several challenges, including:

- Passenger perceptions – unsafe, high fares, unroadworthy vehicles, bad driving /customer service.
- Route competition, illegal operations, taxi violence.

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- High fragmentation with multiple competing associations makes engaging with the industry extremely challenging.
- Low formalisation and limited technological disruption.

Despite its critical role in the transport sector in the province, the MBT sector only receives 1% (Competition Commission South Africa, 2021) of public funding for public transport.

The Blue Dot Taxi pilot in the Western Cape was an initiative that attempted to address the above challenges. Technology formed the Backbone of the Blue Dot pilot, through various hardware and software. The incentive system used existing systems from other projects and the Western Cape Governments Integrated Transport Hub (ITH) to evaluate participants. The ITH is a data repository where municipal and provincial data is analysed to assist key decision makers. These systems and the ITH are discussed below.

Emerging technology in the sector offers potential solutions for overburdened cities and traffic systems, as well as a potentially safer rider experience.

- Opportunities to integrate data sources to better inform decision making, when before it wasn't possible to do so, are supported by transport technology innovations.
- Other provinces in the country are also faced with similar challenges, which could be addressed by existing tried-and-tested solutions.

The aim of this paper seeks to outline the Technologies and Systems used to implement and manage the Blue Dot Taxi pilot and provide an overview of the ITH. For further detail on the Public Transport sector in the Western Cape and further background on Blue Dot Taxi and its achievements, please refer to the SATC paper titled *Minibus Taxi Improvement Initiatives in The Western Cape.*

2.   BLUE DOT OVERVIEW

The MBT sector is characterised by various challenges, as noted above. Blue Dot Taxi was piloted in the Western Cape, focusing on formalisation, service quality improvement and technology-based interventions:

- It was a MBT incentive programme aimed at shifting behaviour and transforming services:
  - Scale: 500 operators, 800 vehicles, and 900 drivers across the Western Cape.
  - Period: Operated from 15 May 2021 – 30 November 2022 (around 18 months).

Technology enabled the accurate monitoring and implementation of Blue Dot, through various hardware and software systems. Participation in the programme was at a provincial, regional, individual operator, and individual driver level. Technology enabled monitoring for Blue Dot performance and compliance at all these levels, and for government & support.

3.   HOW BLUE DOT WORKS

Participants needed to meet various requirements, stipulated through Business Rules. These include:

- Vehicles, their operators, and their drivers needed to meet minimum compliance requirements (valid Operating Licence (OL), Licence, PrDP, Roadworthy, Inspection

etc.) to qualify for pilot. Many of these criteria were checked automatically daily through the integration with various external systems and Blue Dot sub-systems.

- Additionally, vehicles needed to provide a minimum service per day (through driving a minimum distance on their routes) to qualify for the incentive.
- Once compliant, a MBT could earn incentive based on vehicle performance in relation to monitored standards (Speeding, Harsh Driving, Passenger Feedback etc.).
- The monitored standards were initially set to public transport norms, then calibrated using live data outputs from the system.
- Performance incentives were calculated daily automatically through the Blue Dot System. Compliant vehicles who failed to drive in accordance with performance standards did not earn incentives.
- Vehicles from 8 regions in the Western Cape metro & non-metro area participated in the programme.
- Each region was allocated a maximum number of slots, which could be filled with legal participants operating on Blue Dot selected routes.
- Blue Dot selected routes were chosen for participation and agreed upon by government & the taxi industry. Selection was done in a way that ensured most participants on a Blue Dot route were Blue Dot participants.

4. THE INTEGRATED TRANSPORT HUB

All data collected by the Blue Dot incentive system fed into a data warehouse in the Western Cape Government's Integrated Transport Hub (ITH), which is an innovative government approach that leverages the potential of technology to improve transport services in the Western Cape. It is a central data repository for various provincial and local government systems in the Western Cape.

The Hub is a game changer across the sector and is a strong model for integrated, smart system development for government. Examples of benefits created by the Hub include:

- Improving coordination between functions and areas – both within and across municipal and provincial borders / areas of responsibility.
- Allowing quick access to data for planning and reporting functions.
- Ensuring that all data with which decisions are made is accurate and credible, thus enabling better planning, regulation, and enforcement.
- Utilising the latest technology to benefit the safety of South African road users.

The Hub is reliant on external sub-systems providing it with data, an example of which is the Blue Dot ITS described below in **Section 5.4**. All data collected in the Hub is cleaned and stored in one location. This allows end users to query data from multiple sources and compare datasets in ways that were not previously possible.

The development and implementation of the Hub[1] has been a critical enabler for the successful development of the Blue Dot system and technology.

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[1] Various other technologies linked to Hub (in addition to Blue Dot) have also been implemented successfully and have seen efficiency gains, examples of which include:
- eNforce handhelds for Provincial traffic officers introduced into the field have improved efficiencies by enabling officers to receive alerts directly, when possible, transgressions occur in their area, e.g. speeding.
- SANRAL certified Account Based-Ticketing (ABT) back-end software, which enables the roll-out of ABT into the GoGeorge buses. This will allow for interoperability across modes and lower transaction costs for Public Transport authorities.
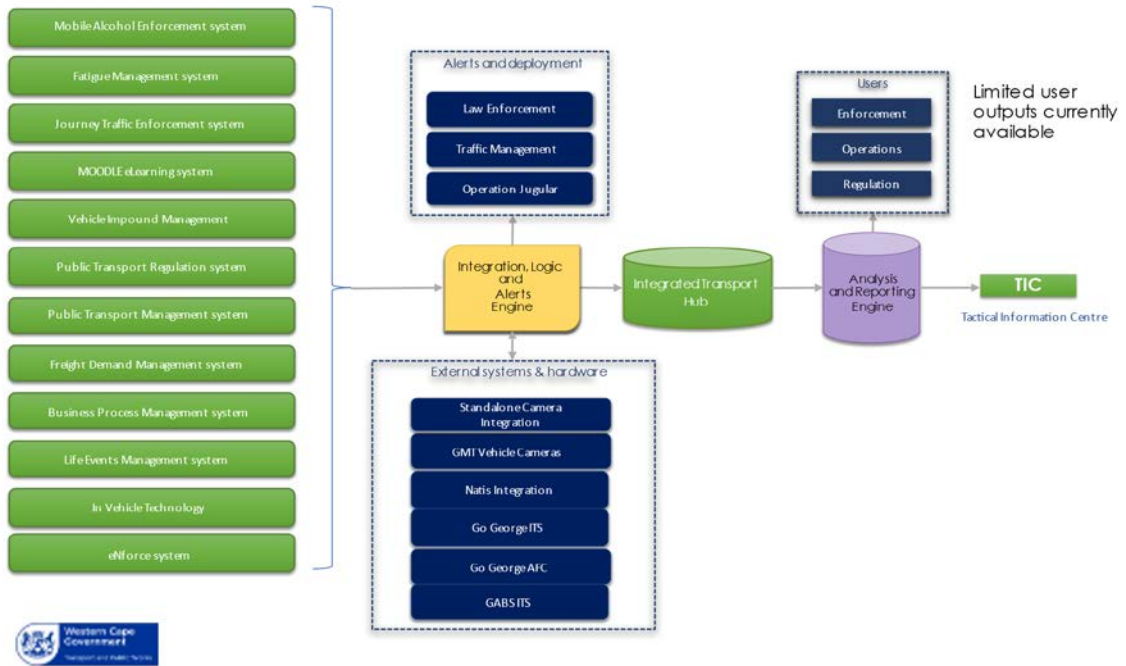- An e-Learning platform is up and running within the Provincial Traffic Service.

Figure 1: Transport Hub Functionality

5.   TECHNOLOGY

The Blue Dot Incentive System used existing systems and the ITH to evaluate compliance and measure performance of participants in relation to the Blue Dot Performance Standards. These solutions, outlined here, enabled the successful implementation of the Blue Dot Taxi pilot.

Divisional security was applied throughout the technology eco-system to ensure participants only had access to appropriate information. The system architecture, which shows the link between various sub-systems and external data sources, is outlined below in Figure 2.
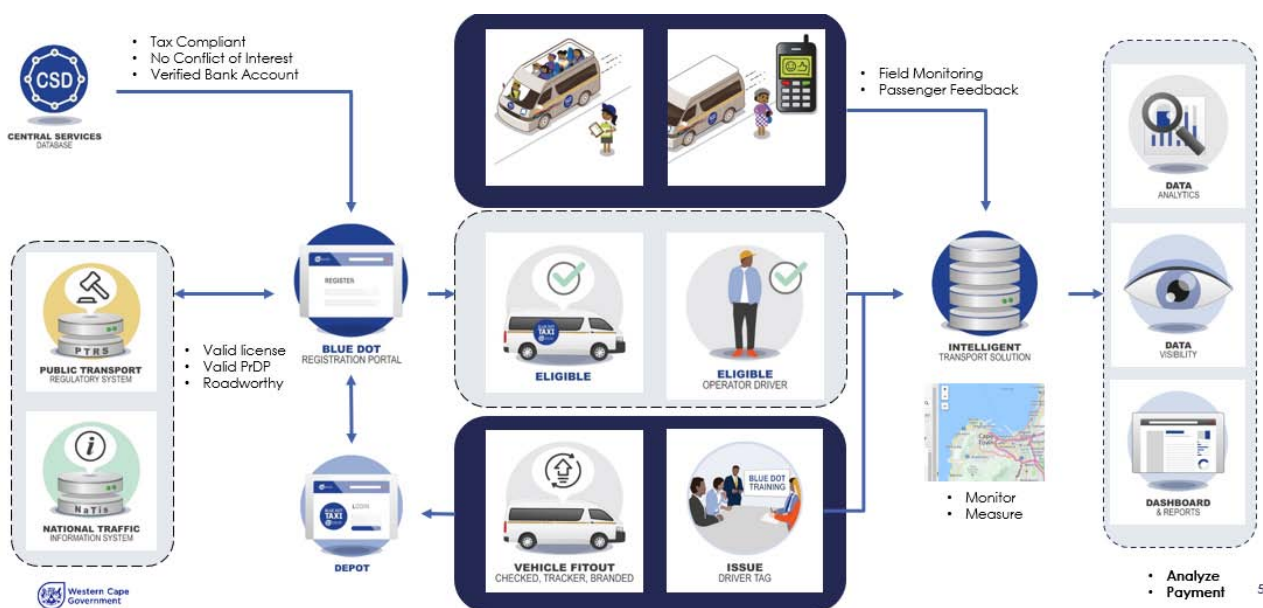
Figure 2: Blue Dot System architecture

5.1   System Hardware

To enable successful monitoring, hardware was provided to participants and installed on vehicles:

- Vehicles were fitted with tracking units to monitor their performance and whereabouts.
- Drivers were given identification tags that fit into onboard tag readers to ensure only authorized drivers are using vehicles.
- Drivers and operators were provided with mobile applications to monitor their compliance and the performance of their vehicles.

5.2   Registration Portal

Companies and participants (operators, vehicles, and drivers) managed the Blue Dot on-boarding process through the Blue Dot Registration Portal. It was mandatory for all participants to be registered on the portal. The portal enabled self-registration/sign-up and allowed participants to accept online terms and conditions as well as privacy policies. Acceptance was recorded by the portal.

Once registered, daily checks were carried out on the participants to ensure continued compliance, including:

- Confirming the vehicle was selected to participate.
- Tax status checks: All operators and companies were required to be tax compliant. This was checked via the Central Suppliers Database (CSD).
- Checks on validity of licence (drivers & vehicle).
- Roadworthy status.
- Checks on validity of operating licence (OL).
- Confirm the participants had met all programme requirements (trained, vehicle fitted with tracker and branding).
- Vehicle had passed Blue Dot safety inspection.

API (Application Programme Interface) integration with external systems were used to conduct these checks. Examples of this include integration with the Public Transport Regulatory System (PTRS) for OL information, and the national eNatis system for drivers' licences, vehicle licences, and roadworthy statuses. Examples of various views in the registration portal are highlighted in Figure 3 below.

Additionally, the Registration portal also integrated with other Blue Dot sub-systems, such as the Depot Application and Intelligent Transport Solution (ITS), both of which are discussed below.

The Registration portal showcases how integrating data from various systems, such as eNatis and PTRS, and displaying these together makes understanding compliance challenges much simpler for service providers. Consolidating this information to a single platform may also be a key initial step to more efficient renewals of these items.
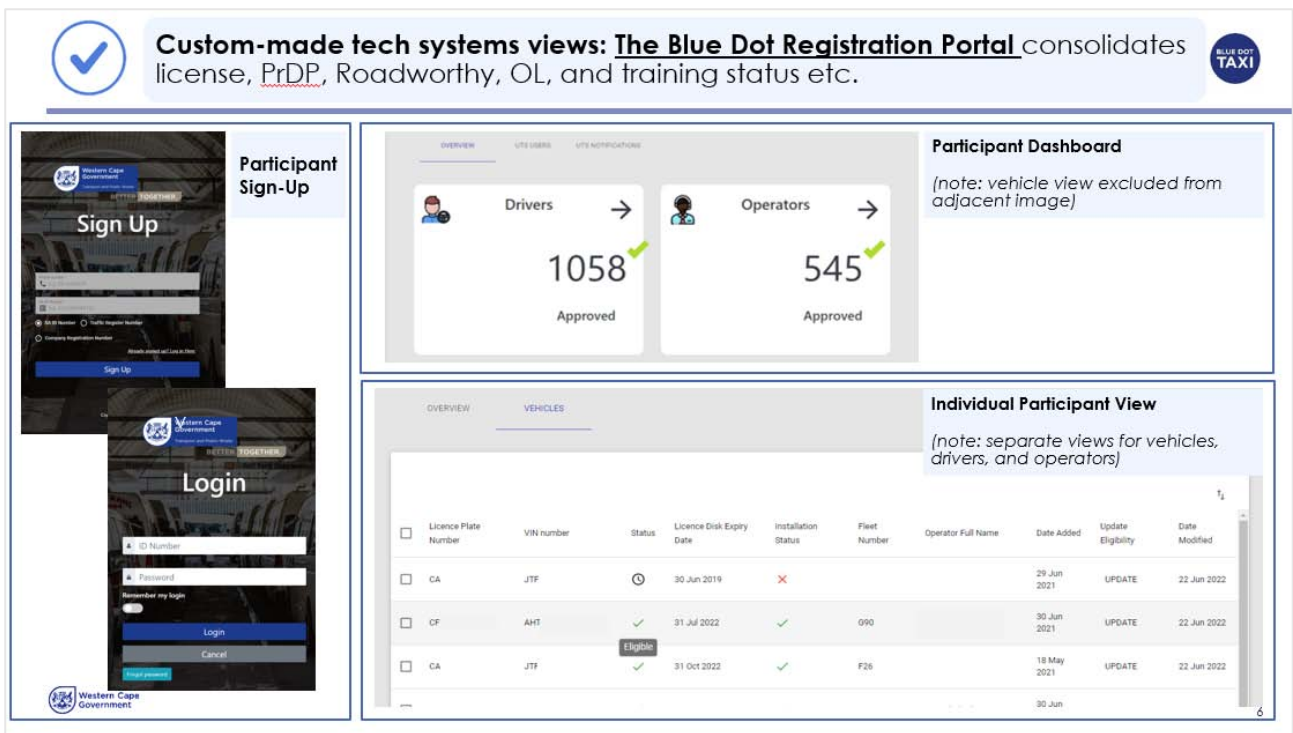
Figure 3: Registration portal snapshot

5.3   Depot Application

The purpose-built depot application is a multifaceted mobile application that was used to manage various operational tasks within the Blue Dot Taxi pilot, including:

1.   Vehicle fitment and decommissioning processes, as well as reporting.
2.   Monitoring vehicle inspections while in the program to ensure vehicle compliance.
3.   Driver and operator training scheduling and attendance registration.
4.   Issuing, replacement and return of driver tags.
5.   Managing and reporting the Blue Dot support queries.

A key element of managing the various onboarding processes was notifying participants of their respective fit-out and training slots. This was done by issuing bulk SMSs to participants via mobile service provider, enabled through API integration.

The Depot application also interfaced with other Blue Dot sub-systems, such as the Blue Dot Registration Portal and Blue Dot ITS. Examples of information shared with the registration portal and ITS include training status, fitment status, and associated additional information such as fleet numbers.

The Depot application allowed for a swift and thorough onboarding of vehicles, drivers, and operators, and ensured those tasked with onboarding participants had access to relevant information via their mobile phones to make the process as efficient as possible. Figure 4 below outlines the main menu of the application and an example a vehicle being fitted out.
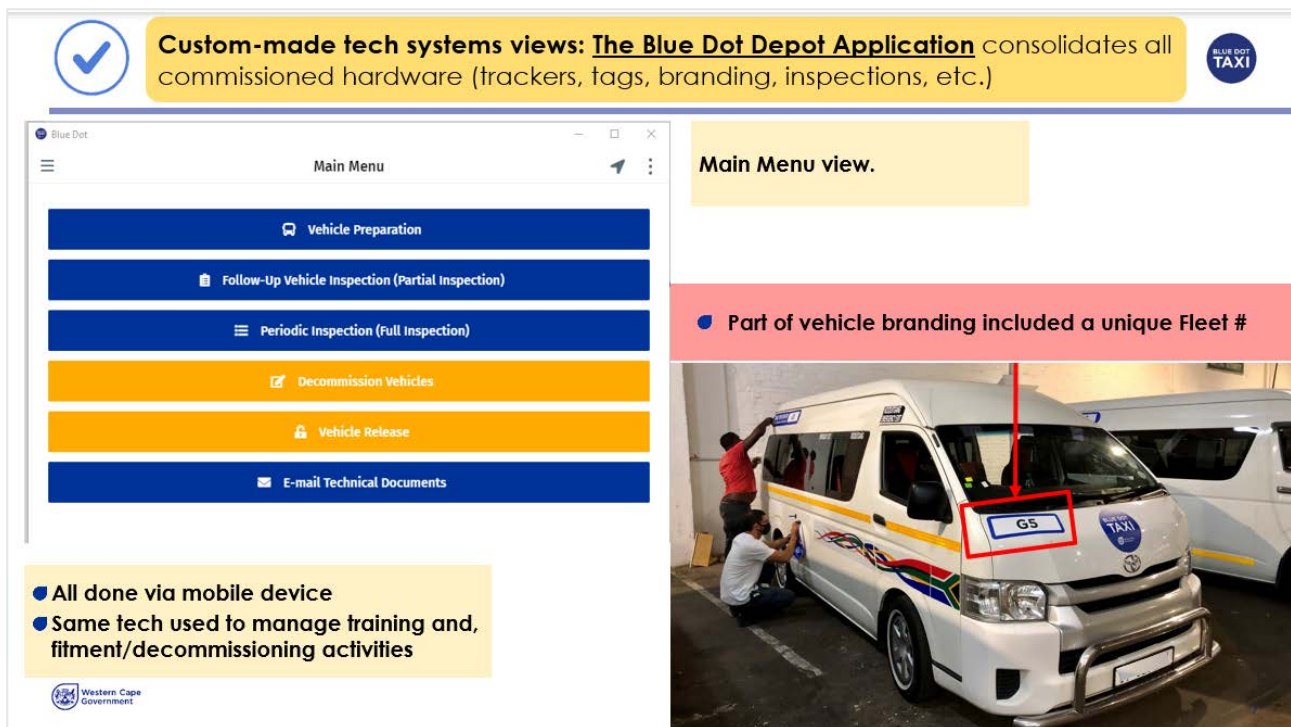
Figure 4: Depot application snapshot

5.4 Intelligent Transport Solution (ITS)

The DTPW-owned ITS has been repurposed from previous / ongoing DTPW projects such as the GoGeorge IPTN (where it is used to monitor service levels) and Red Dot Transport (where it was used to assist with various operational activities such as scheduling and monitoring), to monitor Blue Dot vehicle performance and compliance effectively and efficiently.

In addition to live monitoring, which was facilitated through integration with an external tracking platform, the system applied various business rules and compliance checks to participants. Participants were measured against these rules / checks, which included:

- Compliance checks on operators, vehicles and drivers leading to allocation of Green Status if all checks were passed. These checks were enabled through integration with various external systems such as PTRS and eNatis via the Blue Dot Registration Portal.
- Additionally, the ITS stored all historic compliance checks per participant which could be accessed as reports.
- The system also houses both a route and incentive calculator, which determined the kms travelled on legal OL routes by participants daily during configurable service hours and measured both the vehicle and identified drivers' performance in relation to the standards.
- User feedback & periodic field monitoring inspections were also incorporated into this performance calculation automatically by ITS. ITS consumed passenger feedback via integration with an external mobile service provider through the depot application, which also provided ITS with inspection data.
- Additionally, ITS used the external mobile service provider to send daily SMS to participants indicating their compliance status at the beginning of the day, and previous days driving performance.

- All data also fed into a data warehouse and various BI dashboards, which are further showcased below in Section 5.7.

Figure 5 below outlines examples of some of the functionality of ITS, including live compliance (red/green status), performance (stars) and live monitoring of vehicles.
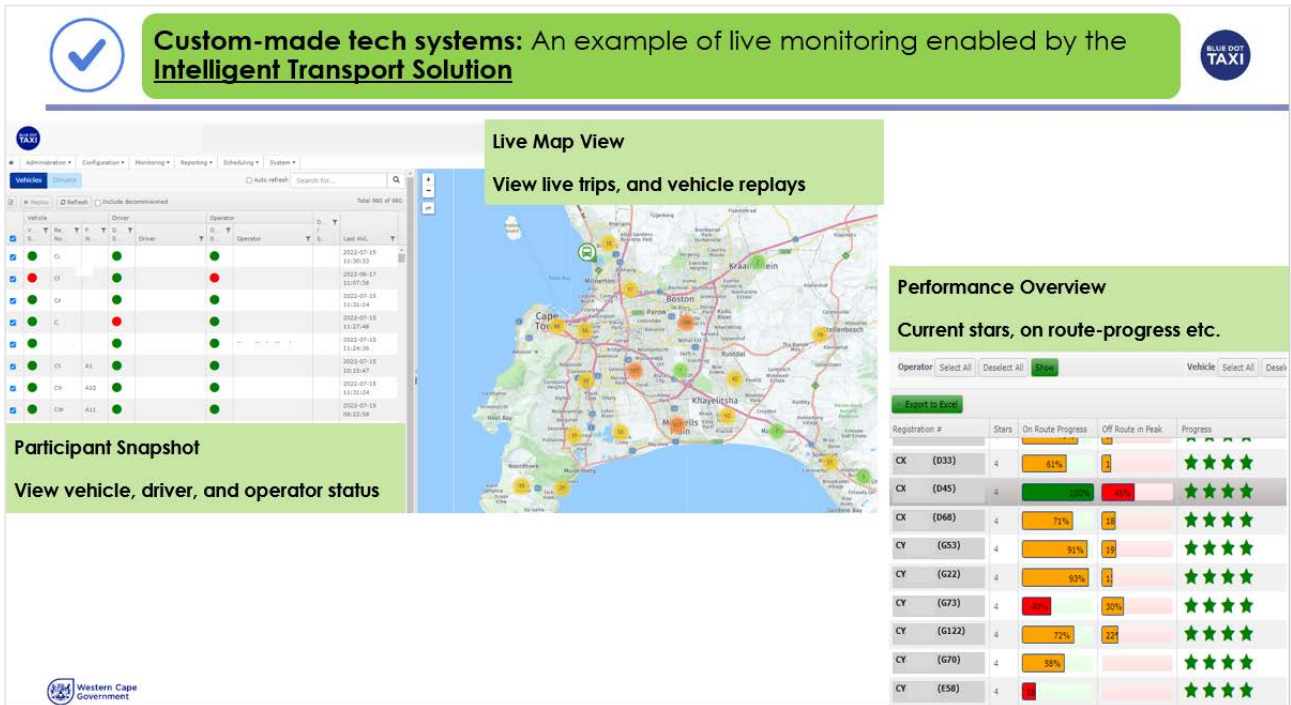

Figure 5: ITS snapshot

ITS was also responsible for automatically generating monthly invoices and supporting evidence for participants to enable payments. All generated documents were encrypted and stored in a secure, secondary encrypted repository.

The government-owned, interoperable solution has shown its multi-faceted functionality and adaptability through various projects, and could potentially be rolled out to other provinces and municipalities looking to achieve similar outcomes.

5.5   Operator Application

Live ITS outputs were made available to participants via the operator application. Examples of some of the application views are outlined in Figure 6 below.

Some of the functionality operators were able to use included:

- Viewing daily compliance and performance of vehicles, including daily performance star losses. Operators were also able to view compliance of linked drivers.
- Viewing live locations of vehicles, vehicle replays, and where stars were lost.
- Viewing monthly invoices, portfolio of evidence, and monthly performance reports.
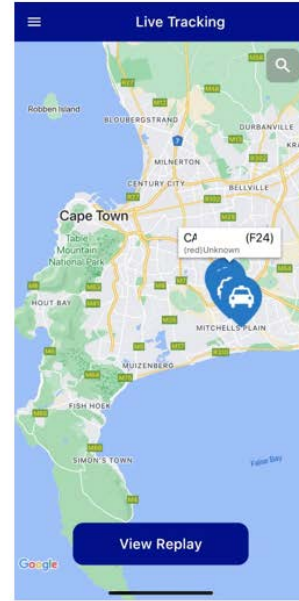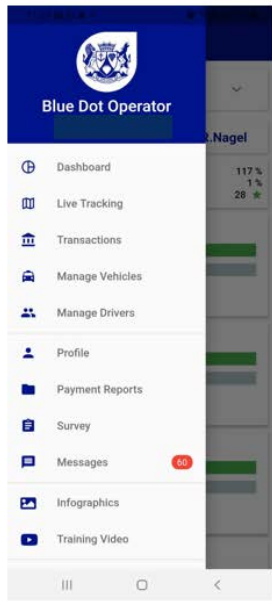- Watching training videos supplied by DTPW.

Figure 6: Operator App snapshot

5.6 Passenger Feedback

MBT Passengers and other road users were able to rate Blue Dot MBTs and their drivers through user feedback system, either via USSD or Whatsapp. Once the survey began, passengers had to answer a selection of questions related to their service experience and were also able to leave free text comments. Examples of the survey questions are outlined below in Figure 7.
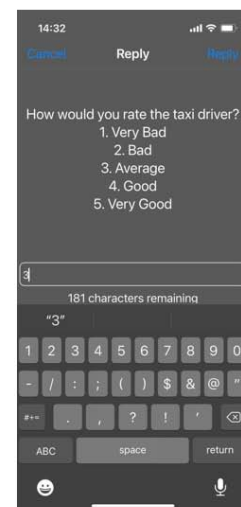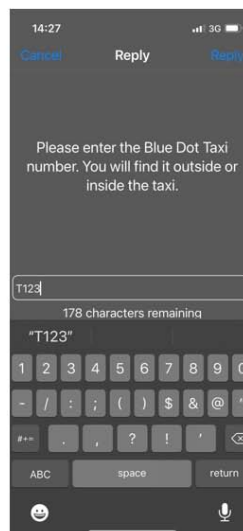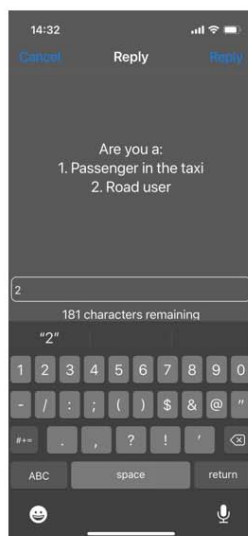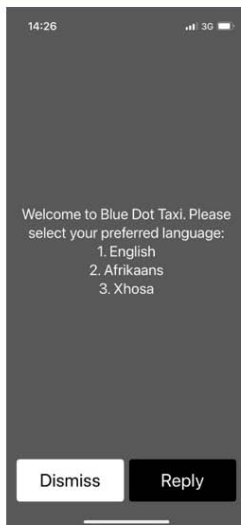

Figure 7: USSD snapshot

User feedback was enabled through integration with an external mobile service provider, and interfaced with the ITS System to expose driver feedback ratings and comments which were included in the daily participant incentive calculation. Passengers were able to easily identify a vehicle through a 2-4-character fleet number, branded on the outside front and back of each participating vehicle. An example of this fleet number is shown in Figure 4.

The User Feedback System empowered passengers and road users to influence the quality of the service they received, provided unparalleled insight into user issues (which was relayed back to participants), and helped create a safer, more dignified, passenger-focused service over time. Over 30,000 ratings were received throughout the pilot, which impacted participant performance, and allowed further disciplinary actions to be taken against repeated offenders and vehicles with allegations of serious misconduct.

5.7   Business Intelligence

Comprehensive operational Business Intelligence reports were made available to Regional Companies and Government on a high-speed reporting interface. Pre-set filters, parameters, and a direct query to the data warehouse provided users with detailed reporting in seconds.

Types of reporting included reports on:
- Star loss.
- Events generated.
- Compliance reports.
- Registration reports.
- User feedback reports.

Examples of the reporting are outlined below. These outputs were used by Regional Companies and Government to manage processes, intervene with participants, and improve performance.
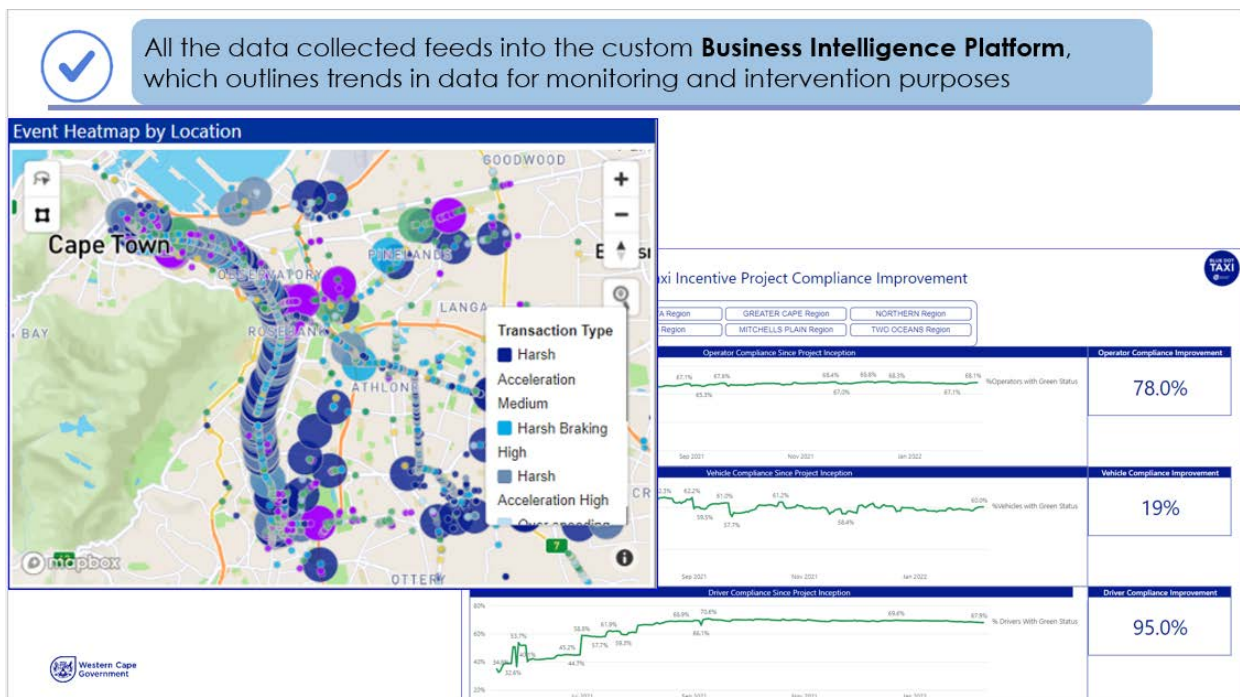

Figure 8: BI snapshot

6.   SYSTEM-ENABLED INTERVENTIONS

6.1   SMS Interventions

In addition to daily compliance and performance SMSs, the system also generated daily SMSs that were sent to participants whose vehicles were being driven by untagged or ineligible drivers, as this directly impacts ability to earn. This intervention was only triggered when a vehicle was driving on one of its legal routes.

6.2   Control Rooms

Various reports and dashboards were provided to Regional Companies to facilitate them monitoring their vehicles performance. Each Regional company had access to ITS, the Business Intelligence reports, and the Registration Portal – providing them with sufficient information to intervene. The figure below shows a typical control room.
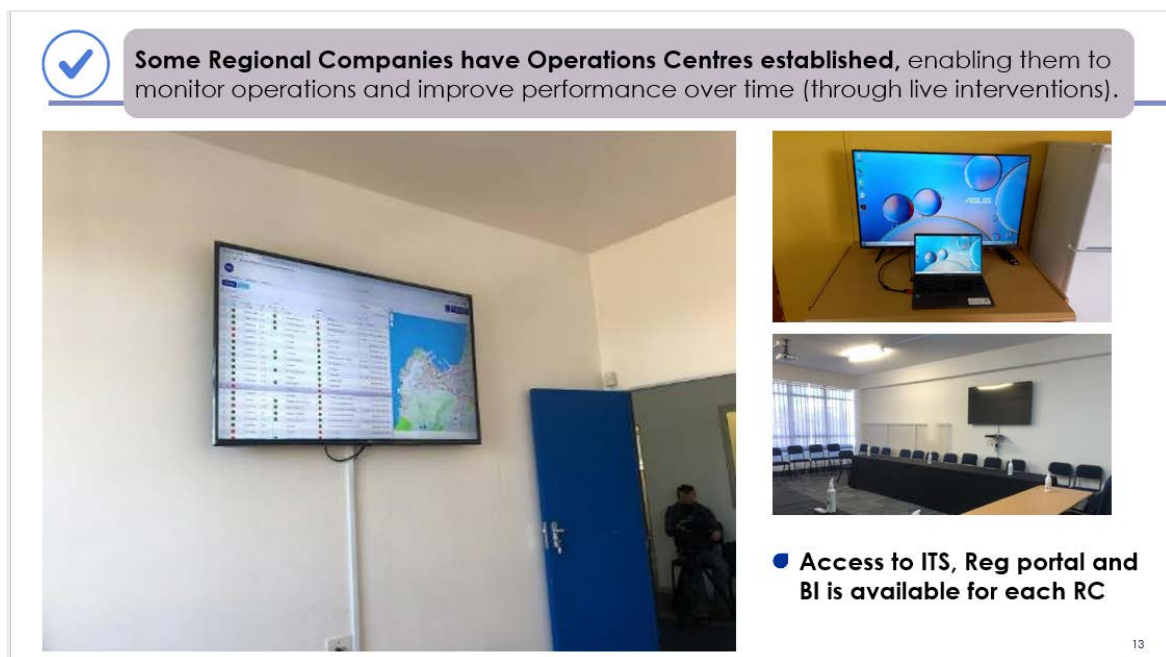

Figure 9: Control room

7.   IMPACT & FUTURE AREAS OF DEVELOPMENT

Over 800 vehicles were branded, fitted with a tracker, and checked for safety, allowing the Department to monitor over 3,3 million kms of minibus taxi operations monthly across 150 routes and providing unprecedented data and insights into minibus taxi operations.

Additionally, the rollout of the first-of-its kind Blue Dot suite of products – a registration portal that integrated with various external systems, the ITS participant evaluation tools such as the incentive and route calculator, passenger feedback systems, an inspection application, and multiple outputs such as applications and business intelligence reports – enabled the effective and efficient implementation of the pilot.

The 18-month pilot, regarded as stage 1 of Blue Dot, focused on introducing the incentive programme, establishing relevant structures, and testing behaviour change receptiveness largely through technology measures. It thus established building blocks for progressive industry formalisation for Stage 2 interventions.

The next stage has been designed to leverage technology further and use established structures and systems to enhance service delivery impact. Some examples of additional technology expansion areas considered for Blue Dot and the minibus taxi industry are outlined in Figure 10 below.

Figure 10: Future areas of development

Blue Dot also highlighted areas where efficiencies could be created through technology and innovation. The Western Cape Government are already addressing one of these areas, with the planned implementation of an online renewal platform for OLs.

8.   CONCLUSION AND WAY FORWARD

Technology will continue to play a critical role in improving the public transport industry. Existing tried-and-tested systems in the Western Cape are already able to:

- Monitor driving patterns and service levels to help drive change, improve efficiencies, enhance passenger safety and accountability of service providers.
- Improve and modernise regulatory processes that are outdated or time-consuming.
- Improve accountability of service providers through mechanisms such as passenger feedback.

The above examples and further components of the Blue Dot System, the ITH, and external systems which feed data into the ITH could be rolled out in other parts of the country to improve existing systems or address similar challenges experienced, and result in:

- More efficient use of existing technology mechanisms, and expansion of these.
- Ability to leverage existing knowledge and lessons learnt.
- Consistency, at a national level, of information coming in and going out.
- Consolidating information from different sources into a single easily accessible platform (either for visibility or comparison).

There have also been various learnings throughout the pilot, and these will be considered when rolling out any future projects or initiatives.

While the Blue Dot pilot has ended due to allocated funding being depleted, the Western Cape Government will continue to innovate and test various technologies in the public transport space, of which valuable insight into improvements can be gained.

9. REFERENCES

Competition Commission South Africa. 2021. *Market enquiry into land based public passenger transport.*

Statistics South Africa. 2020. *National Household Travel Survey.* Pretoria.