

Launch of Robotaxis in Dubai

(Case Study)

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DUBAI HAS SET AMBITIOUS TARGETS TO PIONEER THE FUTURE OF MOBILITY

Today we launched Dubai Autonomous Transportation Strategy, by 2030, 25% of the trips in Dubai will be driverless.

H.H. Sheikh Mohammed bin Rashid Al Maktoum Vice President and Prime Minister of the UAE and Ruler of Dubai April 25th, 2016



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Vision 1.1 **Benefits of Autonomous Vehicles for Dubai**

Dubai's dedication to smart mobility and its pioneering efforts in adopting autonomous driving technologies are due to the fact that autonomous vehicles represent a revolutionary transformation in transportation, offering multiple benefits that can significantly impact society.

> Enable novel urban planning concepts repurposing parking spaces and allocating land more efficiency

Provide cost-effective alternatives to car ownership, saving on fuel, parking, and maintenance

> Transform travel time into productive time and enjoyable experiences for passengers



To ensure the success of autonomous transportation, building public acceptance and enthusiasm for self-driving technology is crucial; therefore, Dubai's society can embrace the future of autonomous vehicles and realize the transformative potential it holds for the future of transportation.





1.2 RTA's strategic partnership with Cruise

RTA and Cruise, a leading technology company for self-driving vehicle technology, have agreed on a strategic partnership to implement autonomous taxis in Dubai.

cruise

This initiative is part of RTA's strategic vision to strengthen Dubai's global leadership in self-driving transportation and support its ambition to become the world's happiest city. Emphasizing smart mobility and advanced technologies, the initiative reflects RTA's commitment to enhancing the wellbeing and safety of citizens, residents, and visitors.

The partnership between RTA and Cruise shows their joint dedication to developing innovative and sustainable urban mobility solutions. It also underlines their shared mission to drive widespread adoption of self-driving technology and promote smart mobility practices.









RTA and Cruise jointly put a plan for implementing an autonomous taxis fleet in Dubai, starting with the first demo ride in December 2023.

Cruise started with data collection and the creation of high-definition maps in March 2023. The target is to commence trial operations of the autonomous Cruise vehicles named Bolt and start a supervised service launch. Starting with a limited number of Cruise Bolt autonomous vehicles in the coastal district of the Jumeirah 1 area, the technology will be initially tested in Dubai as the technology was developed and implemented in the USA.

On 14th December 2023, His Highness Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum, Crown Prince of Dubai and Chairman of The Executive Council of Dubai, went on the first demo ride of the Chevrolet Bolt-based Cruise

Autonomous Vehicle (AV) in the Jumeirah 1 area. After the demo ride in December, Cruise will continue to conduct demo rides with safety drivers for key stakeholders in Jumeirah. At a later date, and following the developmental rides, the RTA will announce a registration process allowing selected members of the public to use the Cruise ride-hailing app to experience the futuristic services of the Cruise Autonomous transport technologies. Dubai is positioned as the first non-U.S. city to commercialize Cruise's self-driving vehicles, planning to deploy up to 4,000 autonomous Cruise vehicles by 2030. To ensure the successful implementation of the project, a list of challenges has been identified and the corresponding proposed solutions, as will be described in the following sections.







Several challenges must be overcome to successfully roll-out a large commercial autonomous vehicle fleet:

Safety assessment of:

- Autonomous vehicles
- Roadways and traffic

Licensing of autonomous vehicles

Service readiness and success measurement

2.1 Safety assessment

The autonomous vehicle system, which has started its operations in the US, is now embarking on an expansion to Dubai. Due to differences between Dubai and US roads, traffic conditions and climate, this expansion poses several challenges that RTA had to solve.

- Firstly, the autonomous vehicle system must be adapted to this new environment to effectively navigate the variety of streets, intersections, and other urban structures.
- Secondly, Dubai employs its distinct system of traffic signs, signals and road markings, diverging from the US regulations. Ensuring precise interpretation and response to these specific traffic rules becomes critical for ensuring safe and efficient operation.
- Thirdly, road-user behavior in Dubai significantly varies from what is observed in the US, with diverse pedestrian crossing habits, an increasingly high number of motorcyclists and varied dynamics of traffic behavior. Accordingly, the autonomous vehicles must possess the capability to detect, classify and predict actions of all types of road users and facilitate harmonious interactions and safe co-existence.
- Another major challenge for robotaxi services in Dubai is the novelty of the technology, which is still unfamiliar to other road users and potential robotaxi customers. Accordingly,

there are still reservations and skepticism from society that need to be overcome. The public needs to be educated about driverless vehicles and the advantages and increased safety they offer.

- Additionally, an adequate physical and digital infrastructure for charging fully electric vehicles, or data transfer and communication, is essential for the operation of robotaxis.
- Lastly, Dubai's climate poses distinct challenges, characterized by seasonal extreme heat and some occasional sand or dust storm, which can impact the performance of sensors, cameras and critical vehicle components. Therefore, optimizing the autonomous system to function reliably under these harsh environmental conditions becomes essential.

Effectively addressing these multifaceted challenges will be pivotal to the seamless integration of autonomous vehicles into Dubai's transportation landscape and garnering public acceptance for this innovative mode of transportation.



2.2 Licensing of autonomous vehicles

The adoption of autonomous vehicles transforms transportation systems but also brings new challenges in the areas of vehicle licensing and inspection. While traditional vehicles adhere to well-established licensing and inspection processes, the unique attributes of autonomous vehicles require reevaluating these procedures.

Existing vehicle licensing and inspection regulations primarily cater to human-driven vehicles. Adapting these frameworks to encompass autonomous vehicles necessitates the formulation of new guidelines that consider the distinct nature of these vehicles. Given the novelty of autonomous vehicles, there are several challenges to overcome to encourage innovation while maintaining public safety.





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2.3 Service readiness assurance and success measurement

Due to the associated challenges with the implementation of autonomous vehicles in Dubai, responsibilities, processes and Key Performance Indicators (KPIs), as well as a suitable organizational structure for service governance, need to be defined.

- The first challenge revolves around defining clear responsibilities among stakeholders regarding an autonomous taxi service.
- Furthermore, KPIs tailored to the autonomous vehicle technology are required to measure the success and performance of the autonomous vehicle implementation effectively. Identifying and defining relevant KPIs is essential to evaluate the impact, efficiency and safety of the autonomous transportation system.







Solutions

3.1 Trialling and evidence-based safety assessment of the Autonomous Vehicle

RTA and its partner Cruise have devised a unique approach to tackle the challenges at hand and ensure the highest level of safety. In doing so, a four-step process is followed, complemented by several support activities.



- Firstly, a local data collection phase is initiated to adapt Cruise Bolt Autonomous Vehicles (AVs) to the Dubai driving environment and ensure optimal performance. Five Cruise Bolt vehicles traverse all roads in Jumeirah 1 repeatedly, gathering data under diverse traffic, lighting, weather and other environmental conditions. Two operators in each vehicle facilitate data gathering from the vehicle's sensors, as well as recording human operational notes.
- Secondly, the collected road- and traffic vehicle data are post-processed by Cruise.



A virtual environment of the road network within Dubai's Jumeirah 1 district is created, including a detailed inventory of road elements and behaviors, enabling the virtual testing and enhancement of AV capabilities. The virtual environment is used to train the autonomous vehicle systems for Dubaispecific environments. Leveraging machine learning technology, autonomous vehicle behavior is simulated and tested within millions of different traffic scenarios and environmental conditions. This enables the validation of the AV capabilities for safe, reliable and efficient driving operations.



- Thirdly, the robotaxis are witnessed and tested in the USA. On the test site, an RTA delegation witnesses and evaluates the safe operation of Cruise Bolt robotaxis in real-world operation within San Francisco, California. Going further, a comprehensive list of safety-critical test scenarios is defined and tested on a closed test track in a controlled environment. This allows for comprehensive testing, including even critical edge cases, which are highly safety-relevant but very rare to observe on public roads.
- Lastly, thorough and extensive trials on Dubai's real-world roads are conducted to validate the performance, safety and traffic rule compliance of the robotaxis. During the trials, the robotaxi drives autonomously through safety critical road sections and challenging traffic scenarios. This ensures that the robotaxi behaves in an exemplary and safe manner, especially considering the novelty of this mode of transport on Dubai's streets.

Ensuring the safe and dependable operation of the all-electric AV fleet requires the implementation of a charging infrastructure. RTA charging sites will be strategically positioned for initial operations.

In addressing all the challenges, Cruise collaborates with Dubai authorities to instil confidence in AV capabilities and ensure compliance with local regulations. Moreover, a standardized AV incident response and escalation protocol is developed for a streamlined and efficient emergency response approach. This partnership and transparent communication foster trust, regulatory compliance and effective incident management in the deployment of autonomous vehicles in Dubai.

3.2 Refined licensing process tailored to autonomous vehicles.

A well-structured approach is followed to design and implement a robust licensing and inspection process for autonomous vehicles, ensuring regulatory compliance, technological validation and seamless operation at scale in the future.



• Status Quo Documentation:

In the first step, the existing vehicle licensing and inspection procedures are thoroughly reviewed. This includes dissecting the current workflow, regulatory requirements and the roles of relevant stakeholders involved in the process.





5 Business Operation Model Definition



Transition to scalability

• International Benchmarking:

An extensive international benchmark analysis is conducted to identify established standards and best practices for autonomous vehicle licensing and inspection. This research provides insights into successful models from other jurisdictions and aids in formulating a well-informed approach.

• Vehicle Classification Definition:

The desired licensing and inspection process is explicitly defined and tailored for autonomous vehicles. This involves classifying autonomous vehicles, determining inspection parameters and outlining comprehensive vehicle documentation requirements.

• Business Requirements Formulation:

The necessary business requirements to effectively operate the targeted licensing and inspection procedures are identified. This includes assessing the needed technological infrastructure, human resources and qualifications, as well as regulatory compliance.

• Business Operation Model Definition:

A thorough business operation model describes the end-to-end process of autonomous vehicle licensing and inspection. This model encompasses workflow procedures, stakeholder responsibilities and data management protocols.

• Inspection Center Implementation:

Key inspection facilities requirements (including tools and equipment) are derived in order to facilitate the setup and deployment of state-of-the-art inspection centers. These centers will serve to conduct thorough inspections of autonomous vehicles, incorporating advanced inspection techniques. In addition, skillsets for technical operators are defined to further support the research of suitable partners to operate such centers.

• Transition to Scalability:

A transition plan is developed to ensure a seamless shift from the initial implementation phase to full-scale operation. This involves progressively ramping up inspection capacities, fine-tuning processes based on real-world data, and addressing any operational bottlenecks.

3.3 Service readiness roadmap, gated success factors and clearly defined responsibilities.

The successful and timely service implementation is ensured by a comprehensive roadmap definition. This requirements roadmap is developed by allocating project success requirements to each phase of the deployment timeline. Lastly, clearly defined roles and responsibilities foster the successful governance of the implementation.

Project success requirements are derived from a thorough investigation of international best practices, all stakeholders' demands, and



relevant experts' involvement. The analysis identifies a list of success requirements, addressing nine distinct categories, such as Infrastructure, Safety Operator Training, Operations, Fleet Management and several more. In order to successfully meet all requirements, more than 100 enablers need to be put in place throughout the project deployment timeline. Requirements include items such as Fleet Operations Management Infrastructure with underlying enablers such as fleet parking depots, inspection centers and maintenance facilities.



Elaborating on the overarching trajectory, the project's roadmap is structured into four principal stages: Preparation, Testing, Supervised Operation and Commercial Operation. The transition from one stage to the next mandates completing the gated success criteria closely linked to the previously identified requirements and enablers. All gated success criteria must be met in order to pass from one stage to the subsequent one. Beyond these foundational success factors, a suite of Key Performance Indicators (KPIs) has been identified. These KPIs serve as dynamic measures to continually enhance operational efficiency during the commercial phase and ensure continuous high safety standards.

Dubai's Roads and Transport Authority achieved a historic milestone, as the RTA issued the first permit to trial Autonomous Vehicles in Dubai at the end of September 2023. The trial permit was officially issued to Cruise, with whom the RTA has a partnership agreement to operate autonomous vehicles in the future in Dubai.



This trial permit is a result of joint efforts of the RTA and Cruise by having successfully tested Cruise's self-driving Bolt vehicles on public roads and a closed test track. The testing took place in San Francisco with the participation of the RTA's technical team. The tests and demonstrations confirmed RTA's confidence in the technology used in the Cruise vehicles which will be used in Dubai.



Conclusion and next steps

Dubai's dedication to smart mobility and its pioneering efforts in adopting autonomous driving technologies are due to the fact that autonomous vehicles represent a revolutionary transformation in transportation, offering multiple benefits that can significantly impact society. To ensure the successful introduction of autonomous vehicles in Dubai, building public acceptance and enthusiasm for selfdriving technology is crucial. RTA and Cruise have agreed on a strategic partnership for the implementation of autonomous taxis in Dubai. This initiative is part of RTA's strategic vision to strengthen Dubai's global leadership in selfdriving transportation and support its ambition to become the world's happiest city. RTA and Cruise jointly take on the challenge of implementing an autonomous taxi fleet in Dubai, starting with the first demo ride with the Cruise Bolt vehicle in December 2023.

Following the developmental rides, the RTA will announce a registration process allowing selected members of the public to use the Cruise ride-hailing app to experience the futuristic services of the Cruise Autonomous transport technologies. The ultimate objective is to operate these vehicles completely autonomously for commercial service.

With this roadmap, Dubai is positioned as the first non-U.S. city to commercialize Cruise's self-driving vehicles, planning to deploy up to 4,000 autonomous Cruise vehicles by 2030.