



Artificial Intelligence in Road Transportation

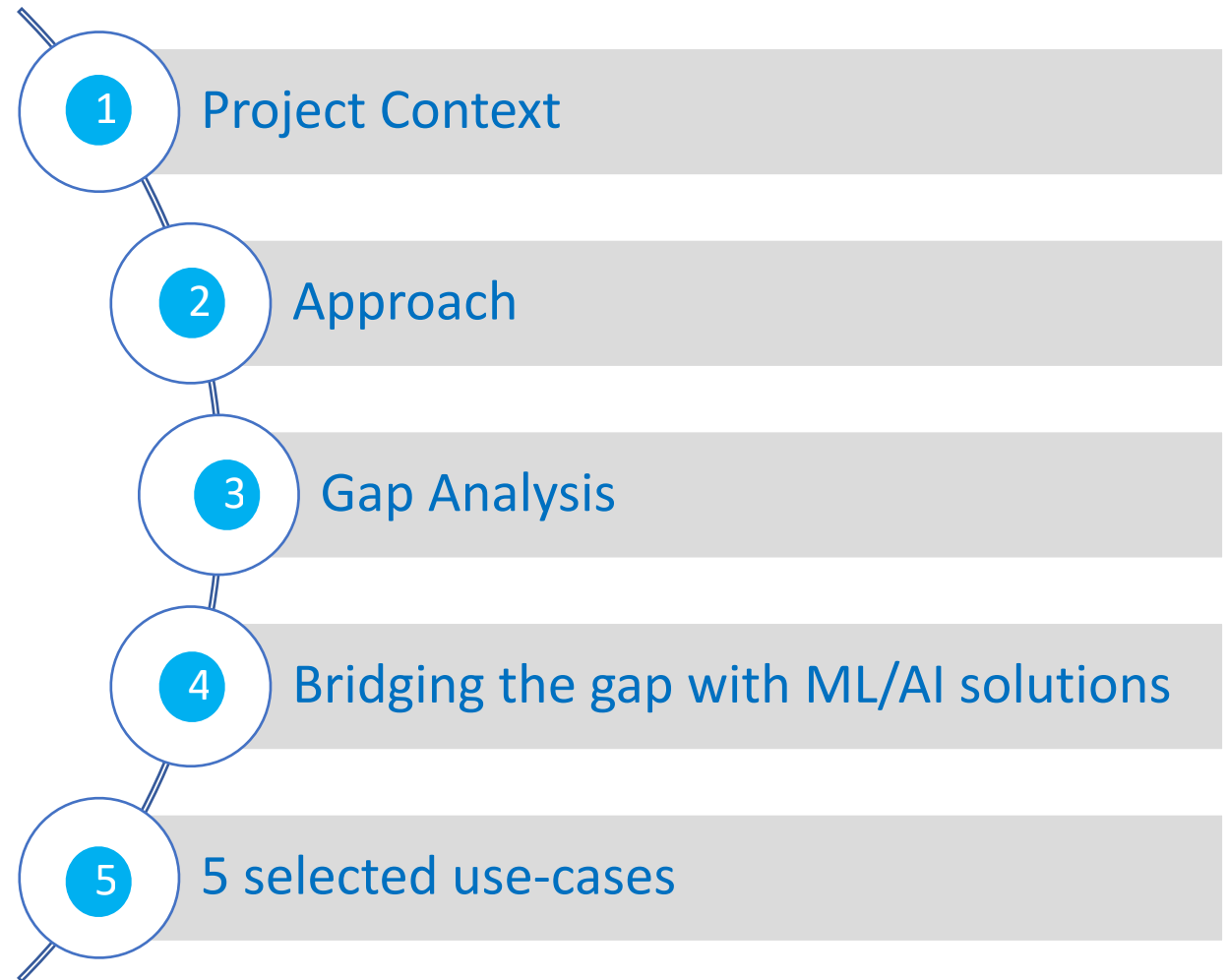
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Project Context

We are asked to enlist potential innovative cases of ML/AI in improving road transport for the Road Transport Authority of an advanced urban city.

Objectives are to identify gaps and to assess challenges in current road transport system and to enlist potential solutions using ML/AI for such challenges.



Approach

1 Segmentation of functions of Road Transport Authority (RTA)



- Transport modes: public, private (fuel), private (EV), shared & sustainable, freight and logistics.
 - Infrastructure: road infrastructure, fleet management, traffic management, parking facilities, toll, ticketing & payment system, pedestrian facilities.
 - Operations and regulations: law enforcement & regulations, revenue & business process management, planning, scheduling & routing system, fraud, cybersecurity & data management system, accidents prevention programs, project planning and delivery.
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2 Gap analysis - identification of gaps in between current state and future expected state of road transportation



- Interviewed and surveyed stakeholders on economical indicators, capacity analysis, demand-supply parameters, traffic performance, modal split, and waiting times.
 - Assessed infrastructure, operational, and regulatory bottlenecks.
 - Ranked 3 RTA functions with 7 KPIs - availability, affordability, efficiency, convenience, sustainability, public perception, innovation & investment.
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3 Identification and prioritization of technological (ML/AI) solutions



- Incorporated broad set of industry data and insights on ML/AI. Leveraged global benchmarks. PwC industry experience in multiple markets.
 - Ranked technological (ML/AI) solutions with 4 KPIs – economic impact, stakeholders' desirability, ease of implementation, cost-effectiveness
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Gap Analysis

7 KPIs for gap analysis in current and future expected state of road transport system

RTA functions	Components	Availability	Affordability	Efficiency	Convenience	Sustainability	Public Perception	Innovation & Investment
1 Road Transport Modes	• Public	8	10	8	5	5	5	5
	• Private (fuel)	9	8	9	9	3	9	7
	• Private (EV)	4	5	4	4	8	4	9
	• Shared & sustainable	5	8	5	5	6	9	9
	• Freight & Logistics	9	8	9	9	3	5	9
2 Road Transport Infrastructure	• Road infrastructure	9		9	9		9	3
	• Fleet management	6		5	4		5	6
	• Traffic management system	8		8	5		8	8
	• Parking facilities	5		5	5		5	8
	• Toll, ticketing & payment system	7		7	9		7	9
	• Pedestrian facilities	8			4		7	5
3 Transport Operations and Regulations	• Law enforcement & regulations	9		5	9		5	9
	• Revenue & business process management	8		5	5		5	10
	• Planning, scheduling & routing system	7		7	7		5	8
	• Fraud, cybersecurity & data management	5		5	7		4	10
	• Accidents prevention programs	7		5	8	5	8	
	• Project planning and delivery	4		4	4	4	4	
	• Portfolio planning	6		6	6		5	
	• Stakeholder management	6		6	6		5	

Bridging the gaps with AI & ML (1/2)

1	RTA functions	Components	Gaps & Challenges	ML & AI based solutions
	Road Transport Modes	Public	<ul style="list-style-type: none"> High demand on capacity and quality Issues related to decentralized, fixity, and connectivity Lack of convenience in ticketing, scheduling, routing 	<ul style="list-style-type: none"> Personal rapid transport (small automated vehicles) Personal travel planning and public transport On-demand transport options and non-peak travel First/last mile connectivity solutions Universal ticketing system and time tables of different modes of transport
		Private (fuel)	<ul style="list-style-type: none"> High traffic congestion and delays Lack of parking facilities Tailpipe carbon emission 	<ul style="list-style-type: none"> Adaptive traffic signals, real-time traffic feedback, weather prediction Obstacles identification, pattern recognition using computer vision Shared mobility Automotive IoT, V2V and V2I technologies use of drones and autonomous vehicle technology Real time smart parking solutions with predictive analytics, computer vision, and IoT Shared mobility; Bikes and electric vehicles
		Private (EV)	<ul style="list-style-type: none"> Lack of charging infrastructure High cost of battery and limited range 	<ul style="list-style-type: none"> Location optimization for charging stations Predictive maintenance and useful-life estimation
		Shared & Sustainable	<ul style="list-style-type: none"> Lack of demand-supply planning Network latency issues leading to poor quality of services Issue of safety and trust in shared mobility 	<ul style="list-style-type: none"> Demand-supply optimization using geospatial analytics Use 5G network and edge computing Predictive and geo-spatial analytics for passengers RFID & NFC technology for seamless user-interaction
		Freight & Logistics	<ul style="list-style-type: none"> Dynamic fuel prices Inefficient supply-chain planning Driver shortage & retention 	<ul style="list-style-type: none"> Predictive analytics for demand-supply of fuel prices Inventory, warehouse, and routing optimization using ML techniques Automated warehouses using computer vision Context-aware active maps Skilling; Advanced driver-assisted solutions; Autonomous and drone technology

Bridging the gaps with AI & ML (2/2)

RTA functions	Components	Gaps & Challenges	ML & AI based solutions
2 Road Transport Infrastructure	Road infrastructure	<ul style="list-style-type: none"> Less or inadequate roads, no-proper maintenance 	<ul style="list-style-type: none"> Pattern recognition for road damage detection, maintenance, and construction
	Fleet management	<ul style="list-style-type: none"> Poor fleet management 	<ul style="list-style-type: none"> Smart fleet management system;
	Traffic management system	<ul style="list-style-type: none"> High traffic congestion and delays 	<ul style="list-style-type: none"> Adaptive traffic signals, real-time traffic feedback Obstacles identification, pattern recognition using computer vision Automotive IoT, V2V and V2I technologies drones and autonomous vehicle technology
	Parking facilities	<ul style="list-style-type: none"> Poor or inadequate parking facilities 	<ul style="list-style-type: none"> Real time smart parking solutions with business analytics and IoT
	Toll, ticketing & payment	<ul style="list-style-type: none"> Poor or inadequate tool, ticketing, and payment infrastructure and system 	<ul style="list-style-type: none"> Smart & integrated tolling, ticketing using non-cash payment system with natural language processing, deep-learning, and computer vision
	Pedestrian facilities	<ul style="list-style-type: none"> Difficulties in pedestrian 	<ul style="list-style-type: none"> Pedestrian detection; repair broken curbs and pedestrian ramps.
3 Transport Operations and Regulations	Law enforcement & regulations	<ul style="list-style-type: none"> Inefficient control of traffic flows, user behavior 	<ul style="list-style-type: none"> Robotic transportation and Delivery solutions
	Revenue & business process management system	<ul style="list-style-type: none"> non-digital revenue collection and distribution. Inefficient manual insurance and business process 	<ul style="list-style-type: none"> Automation, chatbots, and predictive modeling
	Planning, scheduling & routing system	<ul style="list-style-type: none"> Inefficient operations (routing, transit, and maintenance) system 	<ul style="list-style-type: none"> Automation, chatbots, and predictive modeling
	Fraud, cybersecurity & data management system	<ul style="list-style-type: none"> High risk of fraud, data privacy violations and cybersecurity cases 	<ul style="list-style-type: none"> Predictive modeling for prevention of identity theft, privacy violation, financial fraud, industrial espionage
	Accidents prevention programs	<ul style="list-style-type: none"> High rates of accidents on the roads 	<ul style="list-style-type: none"> Computer vision based advanced sensing. Context aware active maps.
	Project planning and delivery	<ul style="list-style-type: none"> Inefficiency, corruption, lack of accountability 	<ul style="list-style-type: none"> AI-based decision system for planning and effective decision making

Prioritization of ML/AI Solutions

No.	ML/AI use-cases	Impact	Desirability	Ease of Implementation	Cost-effectiveness
1	First/last mile connectivity solutions	H	H	M	H
2	Smart & integrated tolling, ticketing using non-cash payment system with natural language processing, deep-learning, and computer vision	H	H	L	L
3	Traffic demand modeling, adaptive traffic signals, real-time traffic feedback, weather prediction	H	H	L	L
4	Delay prediction to reduce wait time using computer vision	H	H	M	H
5	Real time smart parking solutions with predictive analytics, computer vision, and IoT	H	H	L	L
6	Demand-supply optimization using geospatial analytics for fleet services	H	H	H	L
7	Predictive and geo-spatial analytics for passengers' safety	H	H	H	M
8	Fuel price prediction and analytics	H	H	H	H
9	Inventory, warehouse, and routing optimization using ML techniques	H	H	L	H
10	Advanced driver-assisted solutions, computer vision based advanced sensing	M	H	L	L
11	Smart fleet management system	H	M	L	M
12	On-demand transport options and non-peak travel	M	H	H	M
13	Pattern recognition for road damage detection, maintenance, and construction	H	M	L	L
14	Automated warehouses using computer vision	H	H	L	L
15	Context-aware active maps and dynamic route guidance	M	H	L	
16	Driver's behavior analysis using clustering	M	L	H	H
17	Designing an optimal transit network for a community	H	H	L	L
18	Automation, chatbots in transport operation and business process automation	M	M	M	L
19	AI-based decision system for planning and construction	M	M	M	L
20	Predictive modeling for prevention of identity theft, privacy violation, financial fraud, industrial espionage	M	M	L	L
21	Personal rapid transport (small automated vehicles)	M	M	L	L
22	Automotive IoT, V2V and V2I technologies	M	M	L	L
23	Robotic transportation and delivery solutions	H	M	L	L
24	Drone taxis	H	M	L	L
25	Self-driving vehicles	H	M	L	L