Source of image: Cover page of UNECE Global Forum for Road Traffic Safety (WP.1) / Resolution on the Deployment of Highly and Fully Automated Vehicles in Road Traffic

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

FACILITATING THE DEPLOYMENT OF HIGHLY AND FULLY AUTOMATED VEHICLES IN ROAD TRAFFIC ALONG THE ASIAN HIGHWAY NETWORK:

PRESENTATION OF STUDY RESULTS FOR KAZAKHSTAN

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EXPERT WORKING GROUP 1

04 AUGUST 2021

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NATIONAL POLICIES AND PROGRAMMES OVERVIEW

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PRIVATE SECTOR INITIATIVES

NATIONAL POLICIES AND PROGRAMMES OVERVIEW

- The 2020 – 2025 National Infrastructure Development Programme “Nurly Zhol”
  - Provides for execution of “studies and research on institutional and technological framework for the development and introduction of driverless technologies for road transport, railways and sea transport”.
  - The action plan of the Programme does not include any specific actions, nor relevant budget allocations to enable the execution.
- The ICT Priority Activities Roadmap
  - Provides for “design, development, introduction, support, modification and implementation of unmanned vehicle driving systems as well as systems and devices for satellite navigation, mobile communication and emergency transport service calls”.
  - No information is available on the current status of implementation of this action.
- The 2013 – 2022 Development Strategy of National Highway Operator KazAvtoJol JSC
  - Admits that “the introduction of autonomous vehicles, along with the improvement of energy efficiency of the road transport, can create a positive effect for this sector”.
  - The document concludes that the introduction of driverless cars and autonomous trucks has yet insignificant relevance for Kazakhstan.

National policy framework for the development of autonomous vehicles is not in place.
Program documents to streamline the fragmented initiatives and efforts have not been adopted to date.

INTERGOVERNMENTAL INITIATIVES PARTICIPATED BY KAZAKHSTAN

- The 2018 – 2020 EAEU Harmonised Transport Policy Implementation Roadmap
  - Approved by the Eurasian Intergovernmental Council in 2017 to help coordinate transport policies among the EAEU member countries.
  - Paragraph 20 of the Roadmap envisages “creating conditions for planning and conducting joint scientific research to develop and implement advanced transport technologies… including … unmanned vehicles and creating unmanned vehicle traffic zones”.
  - No concrete achievements revealed in Kazakhstan relevant to the Roadmap execution.
- The 2019 – 2024 Navigation Development Roadmap of CIS Countries
  - Enacted by the governments of CIS counties in October 2019 to determine the minimum requirements for the availability (continuity) and precision of navigation data for the needs of road vehicles, including HFAV.
  - As CIS member country, Kazakhstan has adopted the Roadmap for implementation, with no progress reported to date.
- The 2018 – 2020 Action Plan of the Memorandum between the Eurasian Economic Committee and the International Congress of Industrialists and Entrepreneurs
  - Item 9 of the document provides for “formulation of proposals for the member countries to manufacture, in their respective territories, innovative vehicles, including electrically-driven and driverless vehicles”.
  - Partially covered by the ICT Priority Activities Roadmap however no progress has been reported to date.

Intergovernmental initiatives have a clearer agenda and more structured approach to the development of autonomous vehicles however no concrete achievements have yet been visible at country level.

PRIVATE SECTOR INITIATIVES:
MODERNISATION AND TESTING OF DRIVERLESS TRUCK IN NAZARBAYEV UNIVERSITY

- The Study has revealed **only one** private sector initiative related to HFAV which was implemented in 2018-2020.
- It was a joint research project of Nazarbayev University, VIST Group (Russia) and KAMAZ automotive factory (Russia) which included:
  - Installation of automatic driving system onboard a standard KAMAZ-5490 Neo truck comprising lidars, radars, computer vision and positioning systems
  - System integration, programming and finetuning
  - Running static and dynamic tests of the modernized vehicle

- The study was rather a research / educational experiment.
- The modernised truck has not been tested on public roads, nor it was intended for commercial operation in Kazakhstan, and was returned to the owner in Russia once the experiment ended.

KEY TAKEAWAYS:

HFAV POLICY FRAMEWORK AND INITIATIVES

- National policy framework for the development of autonomous vehicles is not in place.
- Program documents to streamline the fragmented initiatives and efforts have not been adopted to date.
- Intergovernmental initiatives have a clearer agenda and more structured approach to the development of autonomous vehicles however no concrete achievements have yet been visible at country level.
- Private sector does not seriously consider AV relevant for their business at the present stage of country's development.
- Only one initiative related to AV was revealed by the Study which was rather a scientific experiment than a commercial undertaking.

SECTION 2:
ROAD INFRASTRUCTURE AND AUTOMATION

ASIAN HIGHWAY ROUTE 9 WITHIN KAZAKHSTAN

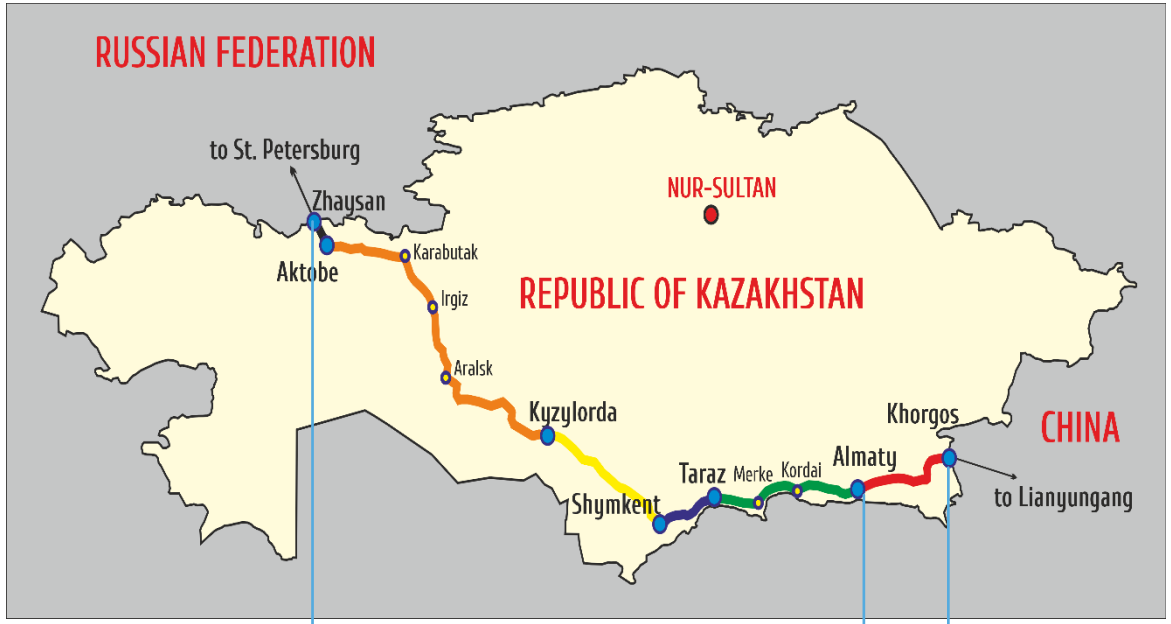
AVAILABILITY OF ITS / AUTOMATION INFRASTRUCTURE

AVAILABILITY OF LTE/4G, 3G AND GSM COVERAGE

AVAILABILITY OF HI-SPEED DATA TRANSMISSION INFRASTRUCTURE

AVAILABILITY OF ROADSIDE FACILITIES

ASIAN HIGHWAY ROUTE 9 WITHIN KAZAKHSTAN (AH9)



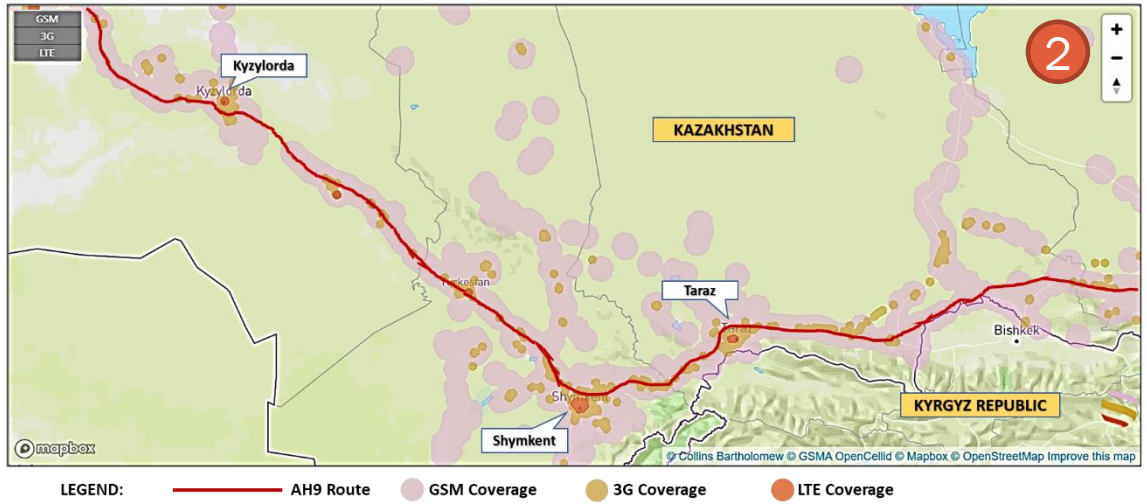
#	AH9 Road section within Kazakhstan	Length, km	Year of Last Rehab	Technical Condition	Category	Designed AADT	Actual AADT	Capacity Utilization
1	Jaysan-Aktobe	99	2013	Fair	II	14000	9260	66%
2	Aktobe-Kyzylorda oblast br	475	2011	Poor	II	14000	9850	70%
3	Kyzylorda oblast br-Kyzylorda	566	2019	Good	II	14000	25140	180%
4	Kyzylorda-Turkestan oblast br	246	2019	Good	I	28000	40620	145%
5	Turkestan oblast br-Shymkent	200	2013	Good	I	28000	26191	94%
6	Shymkent-Taraz	81	Ongoing	Good	I	28000	12190	44%
7	Taraz-Almaty	450	2015	Good	I	28000	11854	42%
8	Almaty-Khorgos	295	2018	Good	I	28000	32129	115%

AVAILABILITY OF ITS / AUTOMATION INFRASTRUCTURE

- Presently ITS elements along AH9 only include tolling system on the Almaty-Khorgos section (295 km) and several automated measurement tools (AMT) for weighing in motion, monitoring of traffic intensity and electronic registration of travel permits at border crossing points
- In short-term, the Government plans to deploy additional ITS elements including:
  - Installation of tolling system on Almaty-Shymkent and Shymkent-Kyzylorda sections in 2021 and Aktobe-Jaysan section by 2025;
  - Installation of nine more AMT stations by 2023 to cover the whole AH9 route;
  - Integration and commissioning of associated road user information services during 2021-2023;
  - Launch of speed monitoring and traffic rules enforcement systems (ongoing).
- New tolling points will use wireless / gateless technologies which will enable seamless passage of AV in the future
- **In general, availability of ITS and relevant automation infrastructure in the country is inadequate for AV operation**

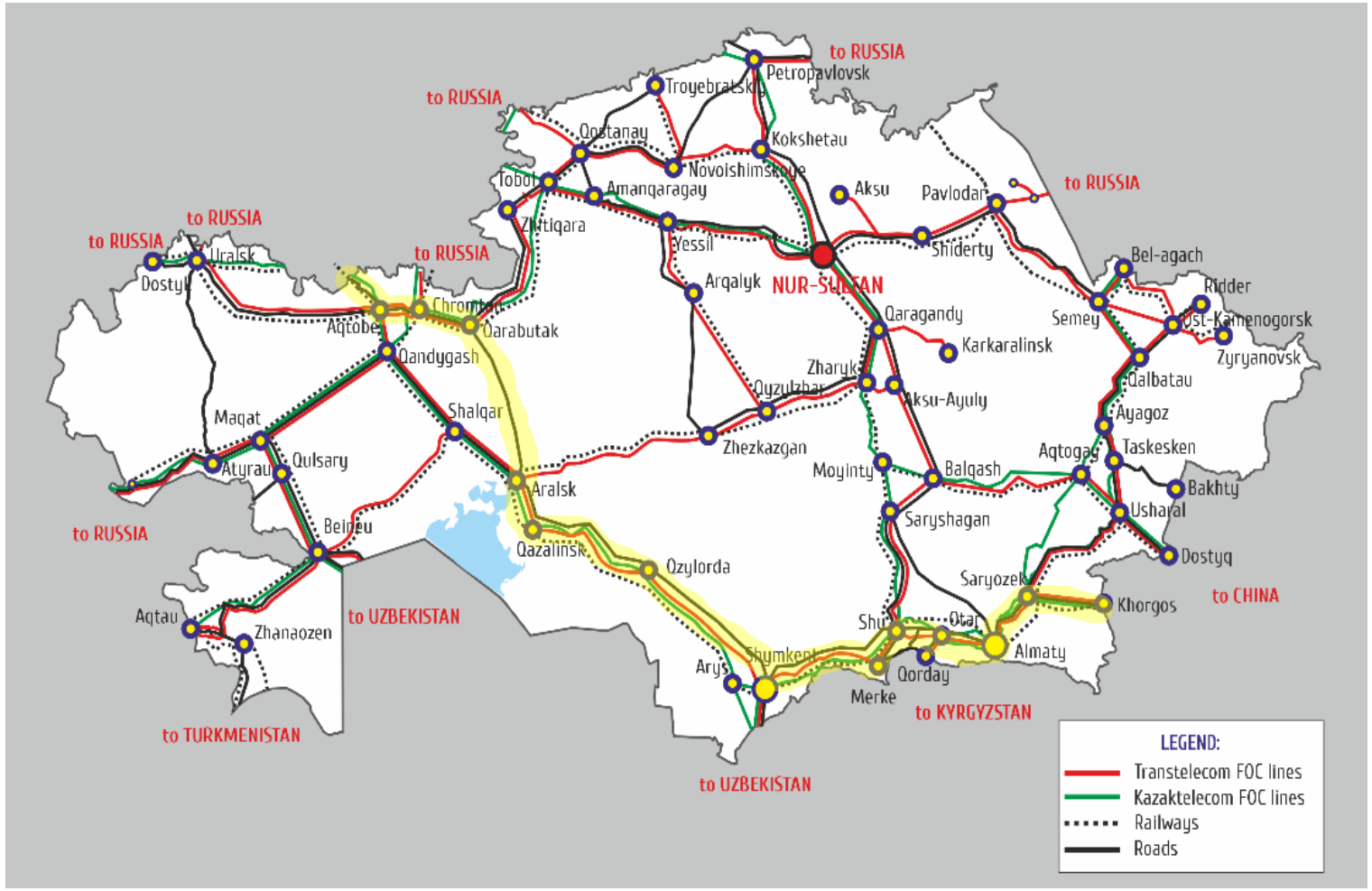



AVAILABILITY OF LTE/4G, 3G AND GSM COVERAGE



- The availability of high-speed wireless data transmission infrastructure along AH9 route is very limited:
  - LTE/4G coverage is only available withing cities;
  - 3G coverage only available within urban areas and their close surroundings;
  - GSM (2G) coverage is available on about 80% of AH9 route;
  - About 40% of Aktobe-Kyzylorda section does not have even GSM coverage.
- Conclusion: AV operation may not be possible

AVAILABILITY OF HI-SPEED DATA TRANSMISSION INFRASTRUCTURE



- Since early 90s over 12,500 km of fibre-optical cable (FOC) lines have been laid, mostly along existing roads and railways
- FOC lines of several operators run along AH9 route on the most part of its length providing possibility for ITS and broadband infrastructure development
- The gap between Aralsk and Karabutak (about 400 km) where FOC does not exist may prevent the deployment of ITS elements and broadband connectivity required by HFAV – **seamless operation impossible**
- It is advisable to consider co-deployment of the missing parts of FOC lines jointly by road authorities and telecom operators.

AVAILABILITY OF ROADSIDE FACILITIES

Class	Available Services and Infrastructure	Spacing, km	Q-ty
A	Refueling, motel, WC, bathroom, retail, canteen, car maintenance, carwashing, guarded parking, cash dispenser, POS terminal, picnic area, medical aid, warming room, tourist office, playgorund, babycare room, laundrywash, trade&entertainment	150 - 240	7
B	Same as A, except ATM machine, POS terminal, tourist office, trade&entertainment	80 - 120	21
C	WC, retail, canteen, picnic area, warming room	20 - 60	94
D	Refueling, WC, retail, warming room	40 - 50	106
Total roadside facilities along AH9 route			228

- The National Standard for Road Facility Design does not require or recommend the availability of HFAV-specific infrastructure at roadside facilities in the country

Official map of roadside facilities from the National Highway Operator KazAvtoJol available at:
https://www.google.com/maps/d/u/0/viewer?mid=11aFToj60yxBdgy4RbyqacfZCdTostrQk&hl=ru&ll=41.40654530339359%2C63.427945139820494&z=5

KEY TAKEAWAYS:

ROAD INFRASTRUCTURE AND AUTOMATION

- Pavement condition and road geometry of AH9 route is good on the most of its length with 1 bottleneck by capacity (566 km within Kyzyolrda oblast) and 1 section being in poor condition (475 km Aktobe-Kyzylorda oblast border)
- Availability of ITS and relevant automation infrastructure and their functionality is inadequate for the operation of autonomous vehicles along AH9 route
- Coverage of high-speed mobile network LTE is very limited, 5G network only exists in one pilot project
- There is no FOC line along Aralsk-Karabutak section (400 km) preventing the deployment of ITS elements and broadband connectivity for autonomous vehicles
- Roadside facilities are scarce and not equipped to serve the specific needs of autonomous vehicles whereas the National Standard does not provide for relevant requirements

SECTION 3:
STUDY FINDINGS AND RECOMMENDATIONS

POLICY

ECONOMIC

SOCIAL

TECHNOLOGY

LEGAL

STUDY FINDINGS AND RECOMMENDATIONS (1)

AREA	FINDINGS (CURRENT SITUATION)	RECOMMENDATIONS
POLICY	• National initiative to support introduction of HFAV is fragmented and unclear	• Determine or establish a national operator to consolidate HFAV public and private initiatives
	• Development of autonomous transport has no explicit coverage in government policies or programmes	• Adopt a dedicated national policy or programme document with a concrete roadmap to Y2025
	• The Vienna Convention on Road Traffic (1968) potentially prevents the operation of AV	• Support the international initiative to revise the provisions that impede the introduction of AV
ECONOMIC	• Higher capital cost of HFAV may limit their accessibility for domestic road carriers	• Introduce financial incentives for carriers (i.e. subsidised interest rates, grace leasing, tax preferences etc.)
	• High cost of road infrastructure modernization to meet FHAV operational requirements	• Co-financing of international road corridor development projects by interested stakeholders and IFIs
	• Huge costs and time needed to develop ICT infrastructure to enable AV operation	• Provide support to telecom operators • Improve conditions for investment and technology development

STUDY FINDINGS AND RECOMMENDATIONS (2)

AREA	FINDINGS (CURRENT SITUATION)	RECOMMENDATIONS
TECHNOLOGY	• Technical condition and limiting throughput capacity of several road sections may jeopardise safe driving	• Provide for reconstruction of Jaysan-Aktobe-Kyzylorda road in the government's road development programme
	• Roadside facilities lack specific services for HFAV (dedicated parking areas, recharging points for electric trucks etc.)	• Provide incentives and support to private sector to foster the development of roadside facilities and enhance their level of service in line with future needs of HFAV
	• Border control points require physical attendance of driver	• Introduce green corridors and appropriate information systems enabling seamless passage of HFAV
	• ITS elements have very limited functionality (only tolling and weighting in motion systems deployed so far)	• Pursue the development of ITS infrastructure in line with the government's policy document Nurly Zhol to Y2025
	• Toll gates require physical presence of the driver	• Consider the use of gateless / wireless technologies for tolling
	• Coverage and speed of existing mobile networks are not adequate for HFAV operation	• Provide support and incentive to private telecom operators to boost the development of LTE and 5G
	• Development of 5G is constrained by high infrastructure costs and lack of available frequency bands	• Provide the interested operators with access to frequency bands operable by standard commercial equipment available on the market

STUDY FINDINGS AND RECOMMENDATIONS (3)

AREA	FINDINGS (CURRENT SITUATION)	RECOMMENDATIONS
TECHNOLOGY	• Digital models for AH9 road do not exists and will have to be developed to enable HFAV operation	• Provide for creation of digital road models under the national digitalisation roadmap
	• FOC infrastructure is not available along Karabutak – Aralsk section (400 km)	• Consider FOC co-deployment during the reconstruction of Aktobe-Kyzylorda road section planned to Y2025
	• Ground-based reference stations are not available	• Provide for the development of reference stations network and give access to data to telecom operators
	• Introduction of HFAV will require specialised training of drivers (AL 2, 3 and 4) and operators vehicles (AL 5)	• Adapt the agenda of technical schools and vocational training centres to meet the demand for skilled drivers and operators
	• Mitigation of potential cybersecurity risks will require additional efforts of relevant authorities	• Amend the data protection law with relevant provisions regarding AV data security and its enforcement
	• Operation of AV in severe climatic conditions may require equipment winterization	• HFAV vendors to make their assessment of the operational conditions and perform vehicle adaptation as may be necessary

STUDY FINDINGS AND RECOMMENDATIONS (4)

AREA	FINDINGS (CURRENT SITUATION)	RECOMMENDATIONS
LEGAL	• National traffic rules do not provide for operation of HFAV	• Introduce the definition of HFAV and other relevant provisions to enable operation and define status of AV
	• Liability associated with the operation of HFAV is not covered by current legislation	• Amend the Civil Code, the Administrative Offence Code and the Criminal Code based on best experience
	• Insurance of driverless vehicles is not covered by legislation	• Introduce legislation to determine the measure of driver / operator liability and third-party damage insurance for different levels of automatization
	• Compliance certification procedure for HFAV does not exist (amendments to EEU regulations underway)	• Ensure validation of the amendments by relevant national and intergovernmental authorities
	• Autonomous vehicles are not defined by customs regulations as a separate commodity group	• Amend the EEU customs regulations to create independent commodity group for FHAV
	• Data protection law does not include any specific provisions regulating the use of automated or connected vehicles	• Amend the law with relevant provisions

KEY TAKEAWAYS:

STUDY FINDINGS AND RECOMMENDATIONS

- Policy and legal framework for autonomous vehicles does not exist in any visible form
- State of infrastructure and level of automation are not adequate to enable the operation of autonomous vehicles
- In the present circumstances domestic carriers do not have any plans to use HFAV for their business
- The magnitude of investments and time required to enable technologically the operation of autonomous trucks along AH9 requires a separate study
- In order to streamline the fragmented initiatives, it is recommended to launch a dedicated technical assistance programme to prepare a Roadmap to Y2030 which would facilitate the development of HFAV in the country

THANK YOU FOR YOUR ATTENTION!

ANDREY YERSHOV, 4 AUGUST 2021

APPENDICES

INTRODUCTION OF NATIONAL EXPERT

TECHNICAL CLASSIFICATION OF ROADS IN KAZAKHSTAN

ROAD CONDITION ASSESSMENT CRITERIA

ROAD USER CHARGES BY VEHICLE TYPES AND ESTIMATED PAY TO PASS AH9

SOCIAL IMPACTS FROM FHAV

COSTS AND BENEFITS OF HFAV INTRODUCTION

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- 20+ years of experience of analytical and consultancy roles for central and local governments, international funding and development institutions.
- Completed over 40 projects and studies for the ministries of transport / infrastructure / agriculture / national economy, regional authorities, ADB, IBRD, JICA and UNESCAP.
- Key career milestones:
  - 1998 – 2002: Project specialist, Ministry of Transport and Communications of Kazakhstan
  - 2002-2003: Transport Sector Consultant, the World Bank
  - 2003-2010: Managing partner, Central Asian Consulting Agency
  - 2006-present: Managing Partner, Research Center for Regional Development and Management
  - 2008-2014: Non-Executive Director, Member of the Board, International Airport Nursultan Nazarbayev
  - 2010-2013: VP Commerce, Locomotive Assembly Factory
  - 2013-present: BD & Customer Director, ALSTOM

TECHNICAL CLASSIFICATION OF ROADS IN KAZAKHSTAN

<table>
<tr><th rowspan="2">Road Class</th><th rowspan="2">Road Category</th><th rowspan="2">Designed AADT (vehicles / car units)</th><th rowspan="2">Total number of lanes</th><th rowspan="2">Median lane</th><th colspan="2">Intersection with transport infrastructure</th><th rowspan="2">Access to road through one level junctions</th></tr>
<tr><th>Roads, pedestrian and bycicle lanes</th><th>Railways and tramway lines</th></tr>
<tr><td>Speedway</td><td>IA</td><td>over 9000
over 14000</td><td>2 and more in each direction</td><td>Mandatory</td><td colspan="2">Split level junctions only</td><td rowspan="4">Permitted if no crossing with onward traffic</td></tr>
<tr><td>Highway</td><td>IБ</td><td rowspan="2">over 7000
over 14000</td><td rowspan="2">4 and more</td><td rowspan="2">Absence permitted</td><td rowspan="3">One level junction is permitted with additional traffic control measures</td><td rowspan="2">Split level junctions only</td></tr>
<tr><td rowspan="2">Partly highway</td><td>IB</td></tr>
<tr><td>IIA</td><td>3000 - 7000</td><td>2 or 3</td><td rowspan="5">Absent</td></tr>
<tr><td rowspan="4">Motor road</td><td>IIБ</td><td>6000 - 14000</td><td rowspan="3">2</td><td rowspan="2">One level junction is permitted</td><td rowspan="4">Permitted</td></tr>
<tr><td>III</td><td>1000 - 3000
2000 - 6000</td></tr>
<tr><td>IV</td><td>100 - 1000
200 - 2000</td><td colspan="2" rowspan="2">One level junction is permitted</td></tr>
<tr><td>V</td><td>below 100
below 200</td><td>1</td></tr>
</table>

ROAD CONDITION ASSESSMENT CRITERIA

Score	Observations	
I	Pavement is stable, transversal profile is maintained, no pavement strains or defects, distance between individual cracks (if any) is over 40 meters.	
	1 - Excellent	Pavement surface is even, no deformations observed.
	2 - Good	Pavement surface is even with rare individual strains that do not impact the speed and safety of traffic.
	3 - Fair	Carriageway has minor bumps, sparse cracks or insignificant presence of other strains.
	4 - Unsatisfactory	Carriageway has significant bumpiness, potholes, pockmarking and other defects impacting speed and safety of traffic. Deterioration of pavement edges and other defects may be observed.
II	Strains are observed that reveal insufficient strength of pavement dispersing over: 5% for capital pavements; 10% for light pavements; and 30% for transition pavements. Longitudinal profile may have occasional strains.	
III	The strains attributable to insufficiant pavement strength are explicit and considerably (more that twice) exceed the indicated values. Spots of fractured surface, potholes.	

ROAD USER CHARGES BY VEHICLE TYPES AND ESTIMATED PAY TO PASS AH9

Types of Vehicles	Fee per km, KZT	Fee $ per 100 km	Pay in 2021, $	Pay in 2025, $
 Cars	1,0	0,23	0,69	4,55
  Buses up to 16 seats / Trucks 1 to 2.5 t	5,0	1,17	3,46	22,73
  Buses up to 32 seats / Trucks up to 5.5 t	10,0	2,35	6,92	45,47
  Buses over 32 seats / Trucks up to 10 t	15,0	3,52	10,39	68,20
 Trucks 10 to 15 t	20,0	4,69	13,85	90,94
 Trucks 15 to 25 t	25,0	5,87	17,31	113,67

SOCIAL IMPACTS FROM FHAV

Factors	Social impact from FHAV	Relevance
	Benefits	
Road safety	Reduced number of deaths in traffic accidents	High
Traffic management	Reduced congestions and time in travel	Low
Time management	Ability to attend to other matters while travelling	Medium
Accessibility	Enhanced mobility for disabled and young users	Medium
Environment	Reduced health impact from air pollution	Low
	Drawbacks	
Ethical issues	Accident liability, “Trolley problem”	High
Affordability	Higher cost, less affordable vs. MD vehicles	High
Inclusiveness	Need for additional training to use FHAV	Medium
Security	Delinquent AI abuse	High
Employment	Loss of jobs (e.g. taxi and truck drivers)	Medium

COSTS AND BENEFITS OF HFAV INTRODUCTION

Effect	Freight	Passenger
Saved driver costs for freight transported by truck	Benefit	
Saved time-value if the driver in the vehicle can do other things		Benefit
Saved fuel due to convoy driving (platooning)	Benefit	
Saved fuel due to smoother driving	Benefit	Benefit
Reduced environmental emissions due to less fuel consumption	Benefit	Benefit
Increased traffic safety	Benefit	Benefit
Increased transportation due to lower generalised costs	Benefit	Benefit
Technology development for vehicles	Cost	Cost
Higher capital costs	Cost	Cost
Changed maintenance cost for FHAV	Cost	Cost
Acessibility for elderly, disabled and non-drivers		Benefit
Perceived change in safety and privacy with FHAV	Benefit	Cost
Changed cost of infrastructure investments	Cost	Cost
Changed land use	Cost	Cost
Changed congestion	Benefit	Benefit