



This project is co-financed by
the European Union and the Republic of Turkey

Instrument for Pre-accession Assistance (IPA II) Programme for Turkey

Technical Assistance for the Open Innovation Autonomous Vehicle Development and Testing Platform Project

EuropeAid/139950/IH/SER/TR

TR14C2.1.02-04/001

Survey Results Report



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1. SITUATION IN GENERAL

By the date of 11 December 2020, in total 76 forms have been received, of which 71 are in Turkish and 5 are in English.

	Received
Turkish Forms	71
English Form	5
Total	76

Software companies, automotive OEMs, SMEs, component suppliers are the groups that show the greatest interest in the survey. Since organization can chose multiple selections, total number of forms are appeared more than number of actual forms as below. The ratios reflect shares in total forms.

Organizations	Turkish Forms	English Forms	Total	Ratio
Software Company	23		23	30%
University & Research Center	15	3	18	24%
SME	18		18	24%
Supplier of Components	13		13	17%
System Supplier	12		12	16%
Automotive Parts Industry	12		12	16%
Car Manufacturer (OEM)	3	1	4	5%
Start-up	4		4	5%
Consortium for smart and clean mobility	4		4	5%
Cluster	2	1	3	4%
NGO	2		2	3%
Consortium for communicating and autonomous vehicles	2		2	3%
Others	15		15	20%

National development agencies, public institutions, engineering consultants, technology advisers are in the other groups.



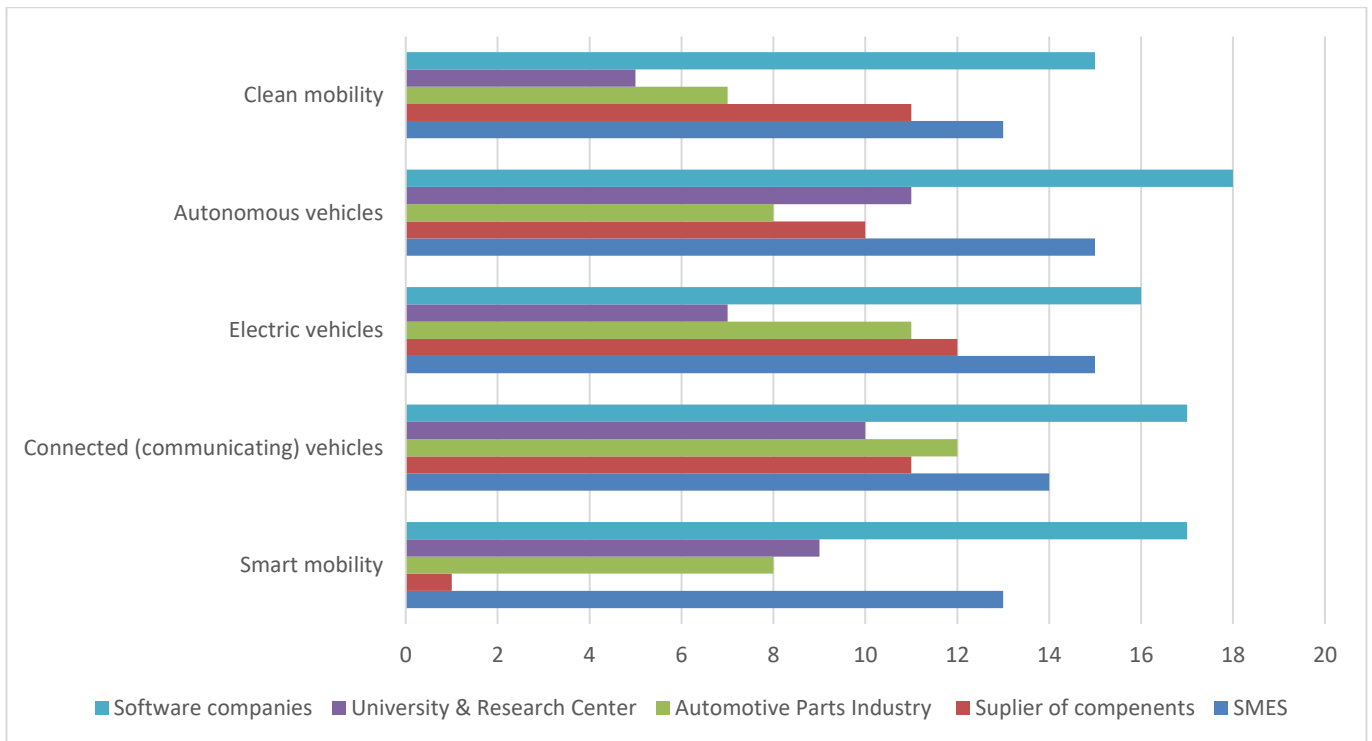
2. QUESTION BASED ANALYSIS

2.1. Sectoral Awareness

Most followed areas are electric and autonomous vehicle sectors while most worked areas are connected and autonomous vehicles as below table showed.

	Do not know	Aware	Following	Working on	Total
Smart mobility	5	17	23	20	65
Connected (communicating) vehicles	3	16	22	24	65
Electric vehicles	4	15	26	20	65
Autonomous vehicles	3	12	26	24	65
Clean mobility	7	20	24	14	65

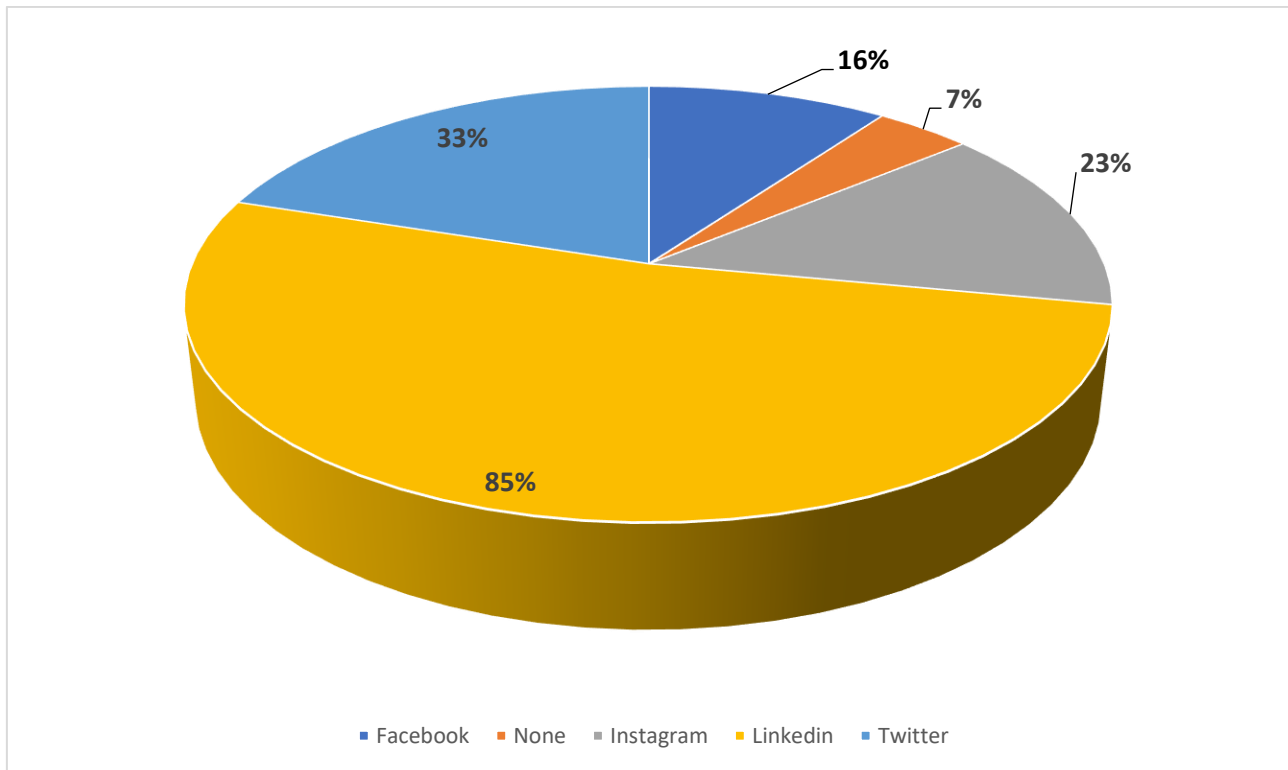
Following figure reflects breakdown of the total of "working on" and "following" selections as of sectoral area and organizations.



Regarding to selections in related questions, universities, and research centers focus to autonomous and connected-communicating vehicles. Electrical vehicle is the area that mostly interested by SMEs and suppliers of component. Automotive part industry is generally showing interest to connected-communicating area while software companies working on and following all area equally.

2.2. Social Media Channels Used in Professional Area

LinkedIn is most preferable social media channel in professional area. Second is twitter and Instagram follows. Common users of LinkedIn are software companies, component suppliers and SMEs.



2.3. Communication Channels in Professional Area

Videos and journals/magazines/papers are most preferred communication channels. Online education platforms are in 3rd line, but it has been developing area by the years especially during the pandemic period.

Channels	Number	Share	Mostly Chosed by
Journals, Magazines and Papers	44	72%	Software Companies, universities and R&D centers
Videos	43	70%	Software Companies
Online Education Platforms	41	67%	SMEs
Sectoral Blogs	33	54%	Software Companies, Suppliers of Components
Podcasts	22	36%	Suppliers of Component, universities and R&D centers
Others and None	2	3%	

Survey results shows that there are also institutional preferences. Online education platforms are important channel for SMEs while component suppliers mostly prefer podcast and sectoral blogs. Software companies may chose/use all kind of tools.



2.4. Followed web Pages

- Autosens
- AV Test
- DigitalTrends.com
- EU Digital Transformation Monitor
- Fuel Cell/Hidrojen/ITER/hyperloop
- Future Agenda
- Gizmodo.com
- <http://www.ausder.org.tr/>
- <http://www.teknolo.com/>
- <https://hexagonpositioning.com/autonomous-x/automotive-positioning>
- <https://ieeexplore.ieee.org/Xplore/home.jsp>
- <https://insideevs.com/>
- <https://trimis.ec.europa.eu/>
- <https://www.electrichybridvehicletechnology.com/>
- <https://www.masinaeolica.com/>
- <https://www.mscsoftware.com/>
- <https://www.sae.org/publications/magazines/automotive-engineering>
- <https://www.tubitak.gov.tr/>
- <https://www.vehicledynamicsinternational.com/>
- Institute for Manufacturing (University of Cambridge)
- ieeexplore
- Mashable.com
- MITTechnologyReview
- National Academies of Science Engineering Medicine
- otam.com.tr
- Patenteffect.com
- researchgate
- science direct
- Strategy +business
- Symposium
- Tech2.com
- TechCrunch.com
- TechRadar.com
- TheNextWeb.com
- TheVerge.com
- Wired.com
- www.industryforum.co.uk
- www.sustainablebus.com



2.5. Cluster/Platform Membership and Approach to Clusters

The survey result of cluster memberships as below mentioned.

Cluster members	29	51%
Not members	28	49%
Total	39	100%

Only 54% of the survey participants are a cluster member and 10 of the cluster members are member of e-hike/e-hikeLink. Also, participants expressed their attention to connect/collaborate with OPINA as below numbers say.

	Members	Non-Members
We are interested, we would like to participate in projects	13	9
We would be interested in becoming a cooperating partner	8	8
We are interested in learning more about OPINA	16	17
We are participating in projects, but we would like to extend our role	4	1
We would be willing to look into a membership	9	13

General Idea	Agree	Disagree
Clusters help to reduce cost	13	15
Clusters provide competitive advantage	20	8
Clusters provide innovative and R&D advantages	23	5
Clusters help to get connected within the industry	26	2
Clusters facilitate access to technology and markets	24	4

Participants generally believe that the clusters are important for information, networking and accessing markets. Participants mostly did not agree that clusters are effective to reduce the cost.

2.6. Expectations / Priorities

Opportunities:

New markets, new partners	36	65%
Getting new ideas	33	60%
Developing a new product	30	55%
Marketing opportunities	23	42%
Strengthening our enterprise	18	33%
Finding testbeds for our developments	16	29%
Lower R&D cost	16	29%
Finding assistance for technical issues	15	27%

Participant's basic expectations from a cluster are access to new markets, marketing opportunities, getting new ideas and developing a new product. Lower R&D cost and also developing new ideas is another important expectation.

When new product development, getting new ideas are thought basic innovation requirement and new market expectation reflects innovation necessity, SMEs and component suppliers are biggest groups needed to innovation.

Networking:

Participation in projects	44	85%
Communication and collaboration opportunities	43	83%
News about technology and trends	36	69%
Participation in workshops	33	63%
Participation in conferences	31	60%
Marketing opportunities	29	56%

Participation in projects, communication and collaboration opportunities and marketing opportunities are mostly chosen selections an expectation from a cluster. equally selected

News about technology and trends, participation in workshops and conferences, participation in projects, communication, and collaboration opportunities and. This situation reflects strong expectations for networking opportunities.

Mentoring / Consulting

Technical consultancy	33	63%
R&D and patent management	31	60%
Marketing consultancy	30	58%
Management consulting	20	38%
Investment consulting	20	38%
Legal assistance	13	25%

Messages of the numbers are clearly that OPINA have to plan consultancy services in technical, marketing and property rights.



Training & Advanced Education

Autonomous technology	35	78%	Most preferred training subjects are consecutively autonomous technology, Automotive software Testing, ISO26262 and AUTOSAR.
Automotive software testing	33	73%	
Artificial Intelligency technology	26	58%	
ISO26262	24	53%	
Vehicle field test	23	44%	
AUTOSAR	22	49%	

2.7. Platform survey results

- 80% of the survey participants have not been engaged on any self-driving vehicle project or collaborative connected vehicles project or have not used similar kind of platforms;
- There are some participants involved on software development projects in the area of Auto mode, V2V, level-2 platooning and level-4 highway pilot functionalities.
- 59% of the survey participants declared that their testing expenses are self-paid.
- MATLAB / SIMULINK and Carmaker / Truckmaker have been preferred as simulation environments for their software development process.
- Most preferred/requested services from the platform are:
 - Connected Car/Autonomous Car System Design
 - Embedded Software Design
 - Communication and Interface Software Development
 - SAE Level 3/4/5 Autonomous vehicle development
 - ADAS application development

It is also interesting to see that invitees were not that much into hardware design (especially computing unit design) and mostly selected autonomous Technology and Embedded software development. The below table is survey results:

Connected Car/Autonomous Car System Design	35	69%
Embedded Software Development	28	55%
Communication and Interface Software Development	26	51%
Model Based Software Development	25	49%
Artificial Intelligence and Machine Learning Technology Development	24	47%
SAE Level4/5 Connected, Collaborating Autonomous Vehicle Development	26	51%
ADAS Application Algorithms Development	23	45%
SAE Level 3 Autonomous Vehicle Development	21	41%
Middleware Development	19	37. %
Autonomous Computing Units Design	18	35%
ACC and CACC System Design	11	22%



- There is a general trend indicating that **open-source simulation tools** and **on the road testing (field testing)** are important services desired by the potential clients and participants responses can be seen in below results table:

Open-Source Simulation Tool	36	71%
On the road Testing	35	69%
In-vehicle Testing	32	63%
MIL/SIL Testing	28	55%
HIL/DIL Testing	26	51%

- Most of the attendees expressed to receive **assistance** related to **autonomous technology development** and **software testing** as can be seen from the below results table:

Autonomous Technology	35	69%
Automotive Software Testing	33	65%
Artificial Intelligence Technology	25	49%
ISO26262	24	47%
Vehicle Field Test	23	45%
AUTOSAR	22	43%

- Regarding **verification and validation**, most of the participant opted for vehicle field testing on road tracks though many of them agreeing on the importance of MIL, SIL, HIL, Open-Source testing and testing in urban traffic:

Test Drive at Driving Test Road Track	33	67%
Open-Source Simulation Testing	30	61%
Hardware in the Loop (HIL) Testing	29	59%
Test Drive in Urban Traffic	26	53%
Model in the Loop (MIL) Testing	25	51%
Software in the Loop (SIL) Testing	25	51%
Driver in the Loop (DIL) Testing	19	39%
Processor in the Loop (PIL) Testing	17	35%

- Regarding the fulfilment of testing requirements of automotive embedded platform projects, most of the participants answered that these requirements were realized by their own test set ups and a minority was seen to fulfill these testing requirements with open-source simulation tools.

- Most participants indicated **Matlab/Simulink as their prospective preferred/ expected software environment from OPINA** as can be seen from the results table below:

Matlab / Simulink	30	68%
Carmaker / Truckmaker	16	36%
Gazebo / Carla / LGSVL	14	32%
Carsim / Trucksim	14	32%
Modelica / OMSimulator	8	18%
LMS AMESim / AMESet	7	16%
Maple / MapleSim	7	16%

- No statistically significant answer could be obtained from the required training certificates in the self-driving vehicles domain.
- Participants mostly indicated that they are familiar with ECU/DCU computing units based on NVIDIA Drive AGX, dSPACE Microautobox and dSPACE Autera Autobox.
- Automated Valet Parking, Car/Pedestrian/ Object Detection and V2X applications has been the most chosen targeted self-driving or driver assisted functionalities and same can be seen from the below results table:

Car / Pedestrian / Object Detection	17	45%
V2X Applications	17	45%
Path Planning / Path Following	16	42%
Traffic Light Recognition and Traffic Signal Detection	16	42%
Automated Valet Parking	15	40%
Highway Autopilot	13	34%
Low Speed Applications (campus bus etc)	12	32%
Driver Warning	12	32%
Urban Automated Taxi (Robotaxi)	12	32%
Lane Keeping	10	26%
ACC	5	13%
C-ACC / Platooning	5	13%
Automatic Emergency Braking System	5	13%

- ISO26262 and ISO /TR 20545 were selected as the most important standards to follow. It is interesting to note that many participants did not acknowledge the importance of cybersecurity and SOTIF and also most of the participants mentioned that they do not have any opinion on the safety and security subject. Below results table indicate the survey results in percentages.



ISO 26262 Functional Safety	20	54%
ISO /TR 20545 Intelligent Transport Systems - Vehicle/Roadway Warning and Control Systems - Automated Driving Systems	16	43%
I Do Not Have an Opinion	15	41%
ISO/IEC 25010 Automotive Software and Data Quality	14	38%
ISO-SAE 21434 Cyber Security	12	32%
ISO/AWI 4272 Intelligent Transport Systems - Truck platooning systems (TPS) - Function and Operational Requirements	11	30%
ISO 21448 - SOTIF	6	16%

- Regarding below tasks,
 1. Requirement Analysis
 2. Testing of AD Algorithms in Simulated Traffic/Road Environment
 3. Hardware-in-the-loop Testing
 4. Testing of Driver-to-vehicle Interaction in Autonomous Driving
 5. Field Testing and Validation with AD Ready Test Vehicles
 6. Utilization of Internationally Accredited Autonomous Driving Test Fields
 7. Sensor Data Collection,
 8. Object Labelling and Annotation from Field Tests and Real Traffic
 9. ISO-26262 Compliance
 10. SOTIF Compliance
 11. AUTOSAR Compliance
 12. Ensuring Cybersecurity
 13. Precertification/Certification
 14. Process for Autonomous Driving Software

It was observed that the least amount of financial/person-hours burden was allocated to ensuring cybersecurity and Precertification/Certification Process for Autonomous Driving Software and the greatest amount of financial/person-hours burden was allocated to requirements analysis.

- Among tasks related to **autonomous driving software development process such as;**
 1. Smart Filtering of Very Big Sensor Data to Identify Corner/Longtail Traffic Situations
 2. Availability and Easy Access of Big Databases to Train Machine Learning Based Autonomous Driving Algorithms
 3. Availability and Easy Access to Virtual Traffic Generation Environments (imported from maps etc)
 4. Autonomous Driving Standard Document Analysis
 5. Derivation of Automotive Standard Compliant and Detailed Technical Requirements
 6. Implementing Computationally Intensive AD Software on Automotive Grade Embedded Systems
 7. Functional Safety Analysis for Large Amount of Possible Traffic Scenarios in Autonomous Driving
 8. High Number of Test Cases for Each Module of Autonomous Driving Software
 9. Test Automation and Requirement Coverage Assurance
 10. Automatic Generation of Simulation Ready Test Cases/Scenarios
 11. Importing of Real Traffic Data to The Simulation Environment
 12. Certification of Developed Software Functions



The participants indicated that tasks 1,2, 7 and 12 were the most complex.

- Finally, following features of autonomous software development platform were deemed equally important by the participants.

Privacy and Protection of Joint Development Environment

IPR Management Assistance

Presence and Easy Reachability of Expert Partner Companies for Possible Collaborative Development

Development Support (mentoring, guidance etc) by Subject Matter Experts

Fast and Reliable Remote Access to Development Platform

Easy-to-Use and Intuitive Collaboration Tools/Interfaces





3. CONCLUSIONS

1. Most of the participants (80%) believe that clusters provide competitive advantage, innovative R&D advantages, help to get connected within the industry and also facilitate access to technology and markets. Interestingly, some of the participants do not believe that clusters will help to reduce cost, but they emphasised that clusters would help a lot on competitive advantage, innovative and networking advantage. Additionally, following suggestions are noticed by participants for getting cluster membership;
 - Trust is required, which is mostly mentioned by OEMs and SMEs
 - Marketing channels, mostly believed by OEMs and SMEs
 - Networking, across participants.
2. As many as possible survey results need to be obtained from experts related to automotive OEMs and Automotive Tier 1s. This is required for effective survey results since the survey is on Autonomous and connected technology.
3. Many participants, especially SMEs suggested to have effective simulation and testing environments.
4. Many participants, especially supply components and SMEs were excited about having an in-vehicle field testing environment.
5. Many participants did not suggest having stringent safety and security measures, which is very important for autonomous platforms and reason might be that the survey is not reached to sufficient experts.