he HARMONY autonomous vehic and drones demonstrations: PIs and impact evaluation framew

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HARMONY's AV and Drones demonstrations

- **Oxfordshire County (UK)**:
  - AV + drones for freight
  - AV bus for passengers
- **Rotterdam (NL)**:
  - AV van for freight
- **Trikala (GR)**:
  - Drone for pharmaceutical purposes

Fleet used for the demonstrations

The Oxfordshire County demonstration

Freight: Autonomous van & drones

Problem:

- The driver needs to drive to every single delivery/pick-up location.
- This is not a problem in city areas where typically a lot of deliveries/pick-ups can be done in small distances,
- But in the countryside, this can lead to long drives to deliver/pick-up each parcel, reducing the number of parcels delivered or collected per hour and increase the miles covered for each parcel
- → decreasing overall efficiency.

Use case:

- The AV equipped with drones can increase the reach of locations, being able to deliver / collect further away from where the autonomous vehicle is.

Demonstration area

UPS Abingdon Depot

Driver's reach with drone

Driver's reach without drone

Driver's reach with drone

Driver's reach without drone

Road

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Demonstration area

Mission:
- 5 deliveries
- 3 collections

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Involved stakeholders

- **Arrival:** autonomous van provider

- **Griff:** drone provider

- **Airbus:** unmanned air traffic management platform provider

- **UPS:** shipping and logistics company

- **Oxfordshire County Council:** public authority

- **NATS:** national air traffic system authority

- **UCL:** scientific guidance and support

The Trikala demonstration

Freight: drones

Problem:

• Pharmacies in villages receive medicines occasionally.

• When they run out of stock, someone has to drive to Trikala to pick up the medicines.

• But usually, elderly people that live in the villages, either call their relatives to deliver the medicines or they have to go/drive to Trikala to purchase them by themselves.

Use case:

- Drone to deliver medicines to pharmacies located in villages upon urgent requests

=> increase efficiency and social care

Demonstration area
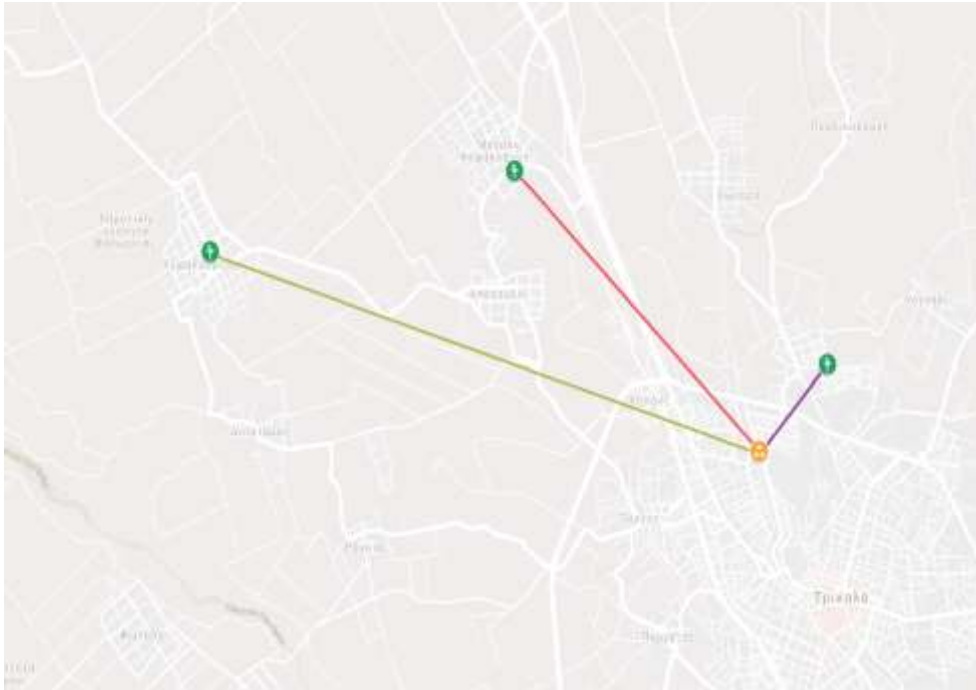
3 routes:
- Trikala to Leptokaria - 1km
- Trikala to Megalo Kefalovriso - 3.4km
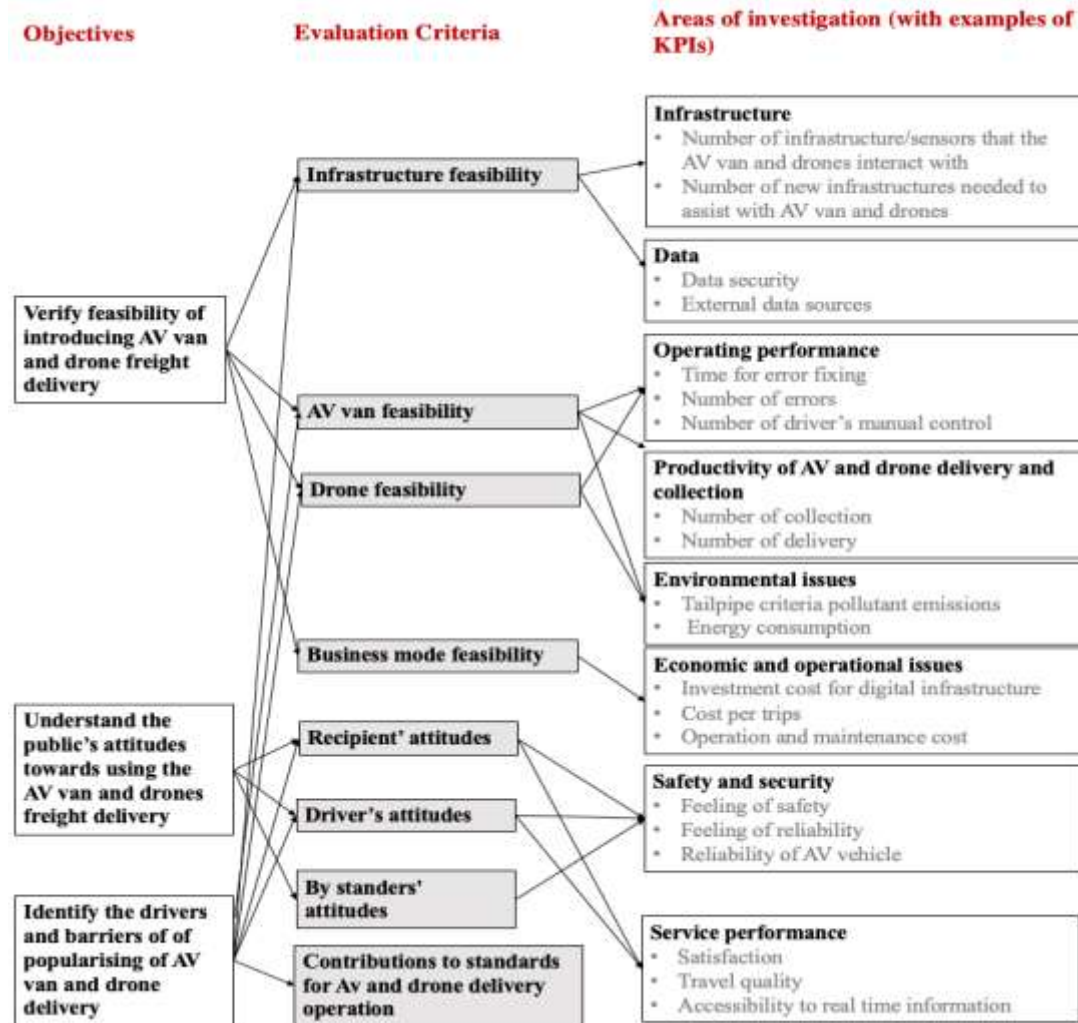- Trikala to Mikro Kefalovriso - 5.74km

Involved stakeholders

- **Griff:** drone provider
- **E-Trikala:** company owned by the Municipality of Trikala / public authority
- **YPA:** Greek national aviation authority
- **UAegean & UCL:** scientific guidance and support

Evaluation & KPIs for the demonstration

AVs & Drones demonstrations impact evaluation framework

Objectives

- Verify feasibility of introducing AV van and drone freight delivery
- Understand the public's attitudes towards using the AV van and drones freight delivery
- Identify the drivers and barriers of of popularising of AV van and drone delivery

Evaluation Criteria

- Infrastructure feasibility
- AV van feasibility
- Drone feasibility
- Business mode feasibility
- Recipient' attitudes
- Driver's attitudes
- By standers' attitudes
- Contributions to standards for Av and drone delivery operation

Areas of investigation (with examples of KPIs)

Infrastructure
- Number of infrastructure/sensors that the AV van and drones interact with
- Number of new infrastructures needed to assist with AV van and drones

Data
- Data security
- External data sources

Operating performance
- Time for error fixing
- Number of errors
- Number of driver's manual control

Productivity of AV and drone delivery and collection
- Number of collection
- Number of delivery

Environmental issues
- Tailpipe criteria pollutant emissions
- Energy consumption

Economic and operational issues
- Investment cost for digital infrastructure
- Cost per trips
- Operation and maintenance cost

Safety and security
- Feeling of safety
- Feeling of reliability
- Reliability of AV vehicle

Service performance
- Satisfaction
- Travel quality
- Accessibility to real time information

Source: Kamargianni, M., Y. Zhan, and L. Yfantis, 2021.

Examples of KPIS

KPI	Unit to be counted
KPIs related to Data and Infrastructure	
External data sources used for the AV demo	To measure what and how many external data sources was required for the vehicles to operate in the real-world environment
Number of infrastructure/sensors that the AV van interacted with	Number of infrastructure and which infrastructure
Communication data security	· Communication throughput including data security number of treated messages per time.
	· Number per time unit.
	· Collection method: self- assessment from solution provider.
Privacy protection	Is privacy ensured according to law / GDPR, i.e. no info about localization and real-time speed transmitted to the cloud?
KPIs related to Autonomous Vehicles used for the demos	
Test rides required – AV vans	Number of rides; duration of rides in minutes
Duration/Time in real traffic situations – AV vans	Duration / Time to be measured in minutes
Number of errors of the AV van during the testing phase	Number and type of errors happened during the testing
Time for error fixing	Hours per error
Number of instances where the driver must take manual control	Number of instances / km
Speed variation (st. dev. of speeds) while travelling at constant speed (on link section, single speed limit)	
Number of road traffic accidents	Number and type of road traffic accident
Number of crashes	
Number of traffic violations	
Energy consumption of a vehicle	liters/100km or electric equivalent
Tailpipe criteria pollutant emissions	(NOX, CO, PM10, PM2.5, VOC) in total per year and per vehicle-km or mile

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Lessons learned so far

Lessons learned

- Companies are positive towards autonomous vans and willing to test them

- They are also positive towards drones, but they have more questions and takes more time to be convinced about the added value of the use cases

- Authorities -both local/regional and national aviation- are supportive and interested in learning through these demonstrations

Drone delivery acceptance survey

http://drones.survey.mobyx.co/

Thank you!

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