Building a government-owned open data platform for connected and autonomous vehicles

Handuo Deng, Qi Hu, ChengHe Guan*, Yi Samuel Chen, Monica Menendez

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About me

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A second year PhD student at Bartlett School of Planning, UCL

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Building a government-owned open data platform for connected and autonomous vehicles

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ABSTRACT

The growing recognition of the societal implications stemming from technological advancements highlights the need for innovative governance approaches, particularly in urban environments. Focused on connected and autonomous vehicles (CAVs), this study proposes an integrated analytical framework for a dedicated open data platform (ODP). By integrating thematic analysis with process landscape and stakeholder analysis methods, we present a holistic CAV-ODP model positioned to optimize benefits across industries, public sectors, and society as a whole. We argue that multiple stakeholders can enhance both supply and demand aspects of the CAV-ODP, catalyzing activities such as data access, management, transformation, incubation, coordination, education, and application. Importantly, it advocates for government-led integration of interests spanning private and public domains, fostering a collaborative social network for data application and innovation. This inquiry not only reveals the social benefits generated by open CAV data but also underlines the significance of the CAV-ODP platform as an innovative governance arrangement, serving as a catalyst for a culture of sharing, bolstering collaborative governance, and preserving public value amid disruptive technological changes. Overall, the concept of government leadership is universally applicable, with the tangible power dynamics among the government, private sectors, and society influencing the expeditious materialization of the proposed framework.

Key concepts

- connected and autonomous vehicles (CAVs)
- CAV open data
- open data platform (ODP)

connected and autonomous vehicles - CAVs

CAVs refer to intelligent vehicles that are both connected and autonomous.

An ***autonomous vehicle (AV)*** is a vehicle capable of driving itself. Automation levels range from 0 (lowest) to 5 (highest) (SAE International, 2019), with fully autonomous vehicles belonging to level 5.

A ***connected vehicle (CV)*** is a vehicle with technology that enables it to communicate and exchange information wirelessly with other vehicles, infrastructure, devices, and external networks (Scharring, Nash, & Wong, 2017).

emerging driving technology + infrastructure network (physical and soft)

CAV open data

the idea that *some* vehicle and mobility data generated by CAVs should be freely available for everyone to use

Appendix C: CAV-related open datasets.

Table C1. CAV-related open data resources at present around the world (Source: Authors. Based on all the websites mentioned in the table.)

Dataset	Intellectual Property	Description	Websites
Waymo Open Dataset	Waymo	The data set isn't for commercial use, but its definition of "research" is fairly broad, and includes researchers at other companies as well as academics.	https://waymo.com/open/
Lyft dataset	Lyft	A dataset of level 5 autonomous vehicles. All data are collected by a fleet of Ford Fusion vehicles.	https://level5.lyft.com/dataset/#explore
Oxford Robotcar Dataset	Oxford Robotics Institute	The Oxford RobotCar Dataset contains over 100 repetitions of a consistent route through Oxford, UK, captured over a period of over a year. The dataset captures many different combinations of weather, traffic and pedestrians, along with longer term changes such as construction and roadworks.	https://robotcar-dataset.robots.ox.ac.uk/
The H3D Dataset	Honda Research Institute USA, Inc.	The H3D is a large scale full-surround 3D multi-object detection and tracking dataset. It is gathered from HDD dataset, a large-scale naturalistic driving dataset collected in San Francisco Bay Area.	https://usa.honda-ri.com/h3d
The nuScenes Dataset	nuScenes	The nuScenes dataset is a large-scale autonomous driving dataset. Two diverse cities: Boston and Singapore Free to use for non-commercial use	https://www.nuscenes.org/
ApolloCar3D	Apollo	The first large-scale database suitable for 3D car instance understanding.	ApolloCar3D: A Large 3D Car Instance Understanding Benchmark for Autonomous Driving arXiv:1811.12222 [cs.CV]
KITTI Vision Benchmark Suite	Andreas Geiger	Our datasets are captured by driving around the mid-size city of Karlsruhe, in rural areas and on highways. Our goal is to reduce this bias and complement existing benchmarks by providing real-world benchmarks with novel difficulties to the community.	http://www.cvlibs.net/datasets/kitti/raw_data.php
The Cityscapes Dataset	Cityscapes Team	The Cityscapes Dataset focuses on semantic understanding of urban street scenes. In the following, we give an overview on the design choices that were made to target the dataset's focus.	https://www.cityscapes-dataset.com/dataset-overview/
Mapillary Vistas Dataset	Mapillary AB	A diverse street-level imagery dataset with pixel-accurate and instance-specific human annotations for understanding street scenes around the world.	https://www.mapillary.com/dataset/vistas?pKey=xyW6a0ZmrJtjLw2iJ71Oqg&lat=20&lng=0&z=1.5

Supplementary data online https://doi.org/10.1016/j.cities.2024.104918

Lidar

- Two roof-mounted VLP-32C lidar sensors (64 beams total)
- Overlapping 40° vertical field of view
- Range of 200 m
- On average, our lidar sensors produce a point cloud with ~ 107,000 points at 10 Hz

Cameras

- Seven high-resolution ring cameras (2048 width x 1550 height) recording at 20 Hz with a combined 360° field of view. Unlike Argoverse 1, the camera and lidar are *synchronized*. The camera images are captured as one of the two lidars sweep past its field of view. The front center camera is portrait aspect ratio (1550 width x 2048 height) to improve the vertical field of view.
- Two front-view facing stereo cameras (2048 x 1550) sampled at 20 Hz

Localization

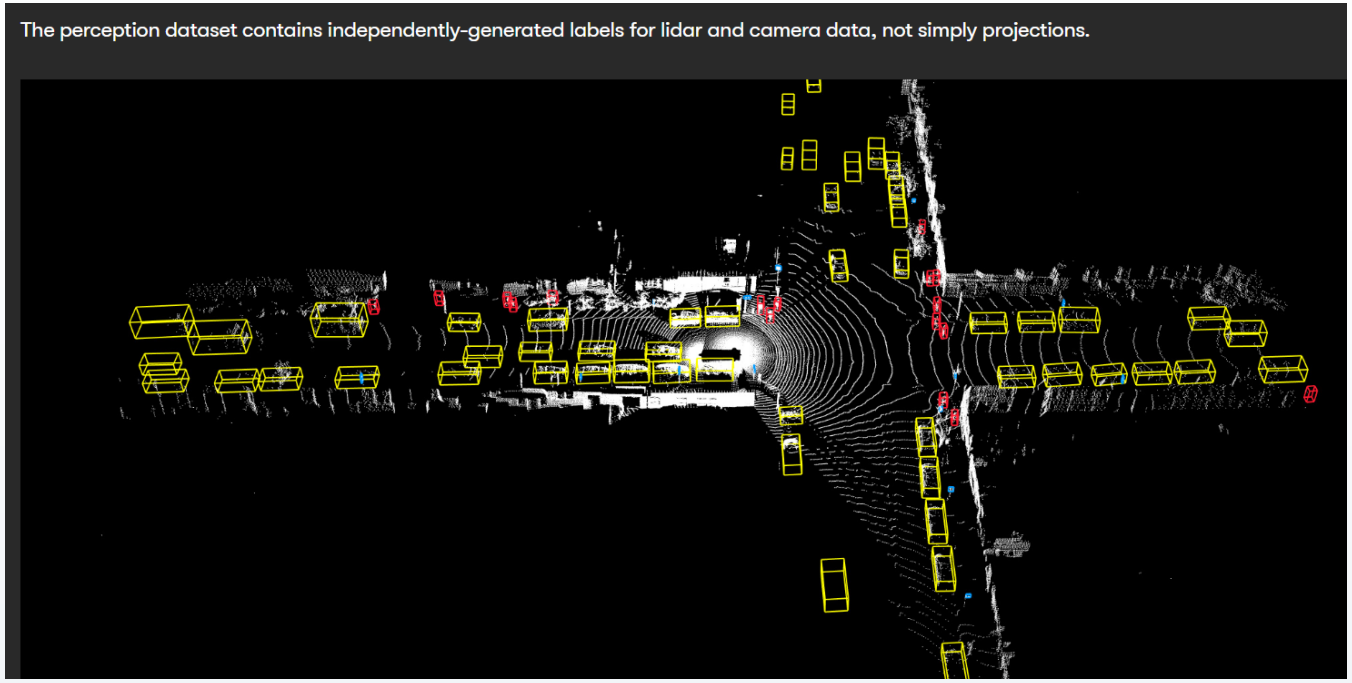
We use a city-specific coordinate system for vehicle localization. We include 6-DOF localization for each timestamp, from a combination of GPS-based and sensor-based localization methods.

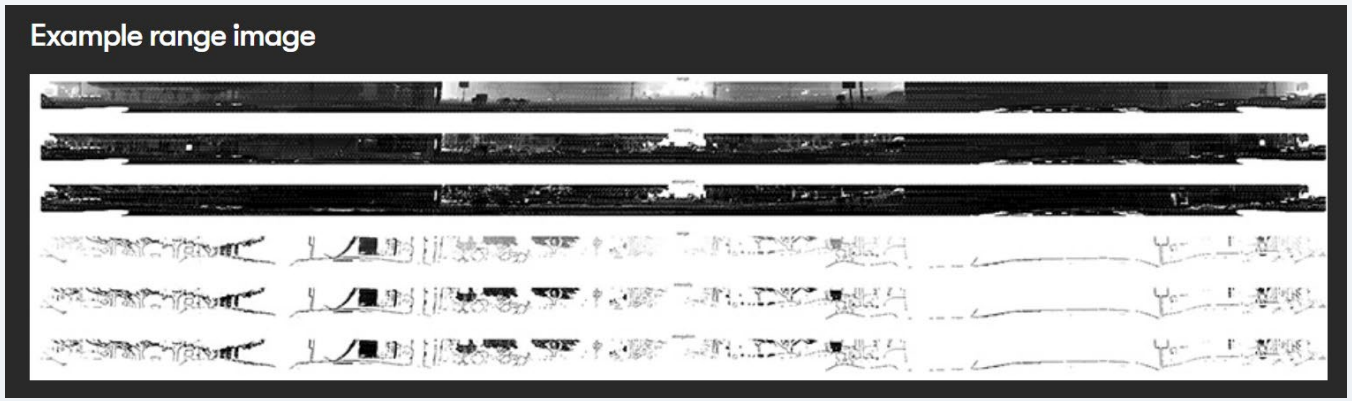
Calibration

Sensor measurements for each driving session are stored in "scenarios." For each scenario, we provide intrinsic and extrinsic calibration data for the lidar and all nine cameras.

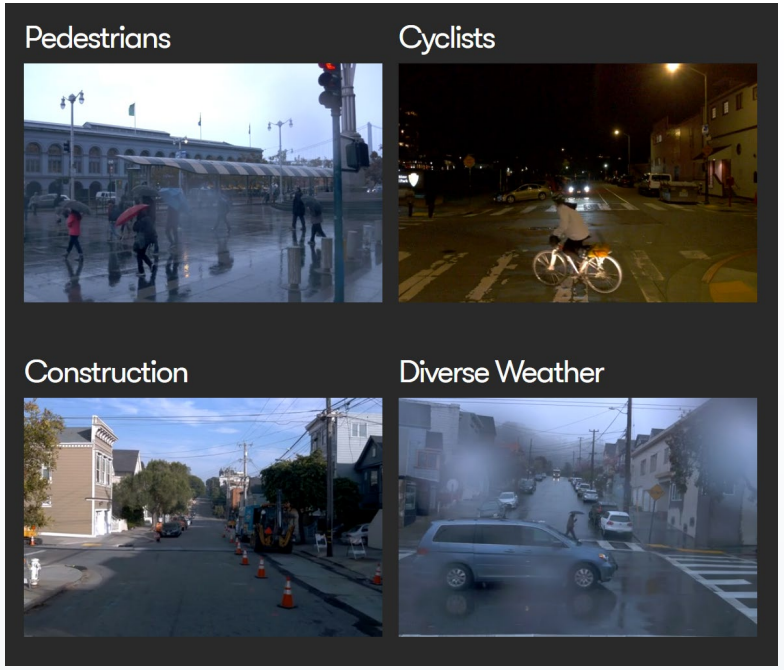
https://www.argoverse.org/av2.html

Examples of CAV open datasets





https://waymo.com/open



Classifications of CAV data

NOT All data should be open

Potential use, intellectual property, and data protection of data	Non-brand differentiated data	Data not differentiated by vehicle manufacturers and not considered IP-sensitive
	Brand differentiated data	Data differentiated by vehicle manufacturers and considered IP-sensitive
	Personal data	Data that supports services requiring user or vehicle identification, very sensitive from a privacy perspective

(Source: Taeihagh & Lim, 2019; Yin & Berger, 2018; Somers & Austroads, 2018; Scharring et al., 2017; Darwish, Bakar, Kaiwartya, & Lloret, 2020; also see Table C1 in the Appendix for additional examples.)

Table 2
Classifications of CAV generated data.

Classification Criteria	Subclassification	Examples/Definition
Machines to collect and store data	Collected data	Data generated by radar, lidar, sonar, GPS, odometry
	Storage data	Data generated by inertial measurement units, central computer, vehicle users, third-party apps
Content of data	Technical data	Data related to vehicle operations and driving process, including speed, acceleration, fill and consumption levels, battery status, lane change, brake activation, as well as the decision-making process of the vehicle
	Geolocation data	Location and route of a certain vehicle
	Environment data	Weather conditions, temperature, sunlight, etc.
	Urban society data	Road system, city infrastructure, traffic accidents, number of pedestrians and vehicles, human interventions,

open data platform (ODP)

A specific arrangement of using open data

existing ODPs mainly deal with open government data (OGD)

Business models of ODP: value generation

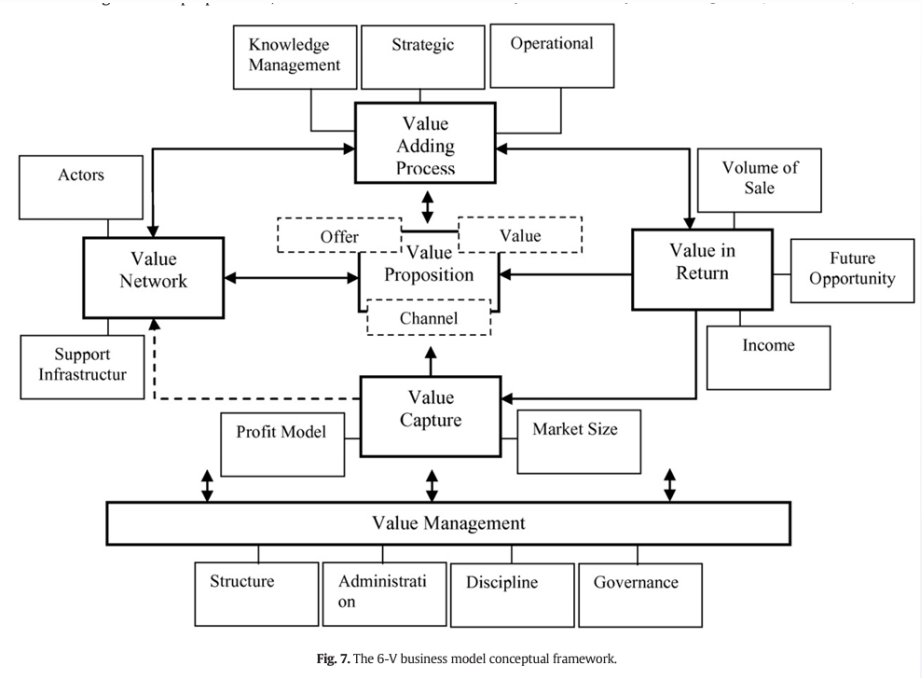


Fig. 7. The 6-V business model conceptual framework.

(Zeleti et al., 2016)

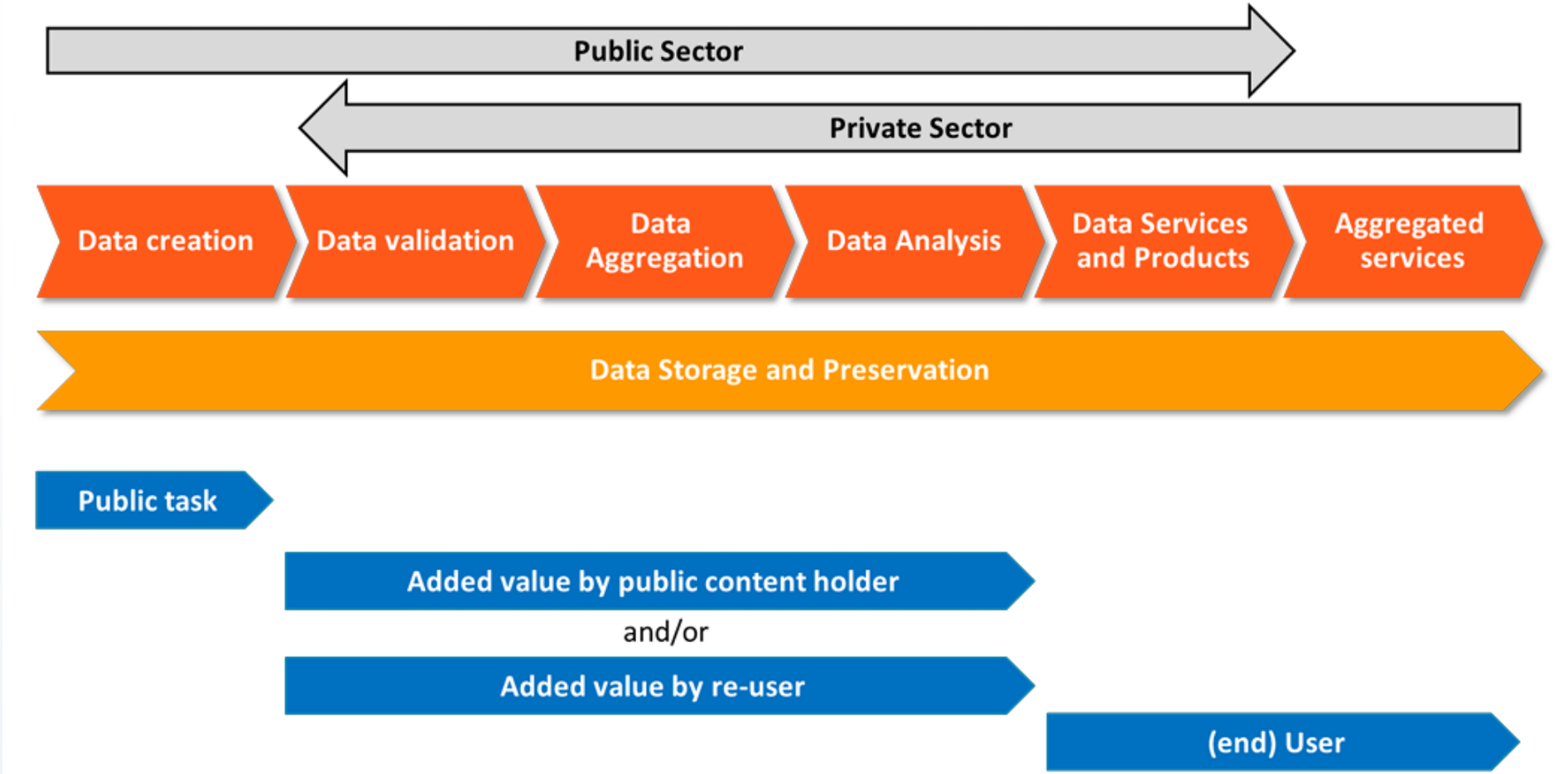


Figure 9: Open Data Value Chain

Berends J., Carrara W., Engbers W., Vollers H. (2020).

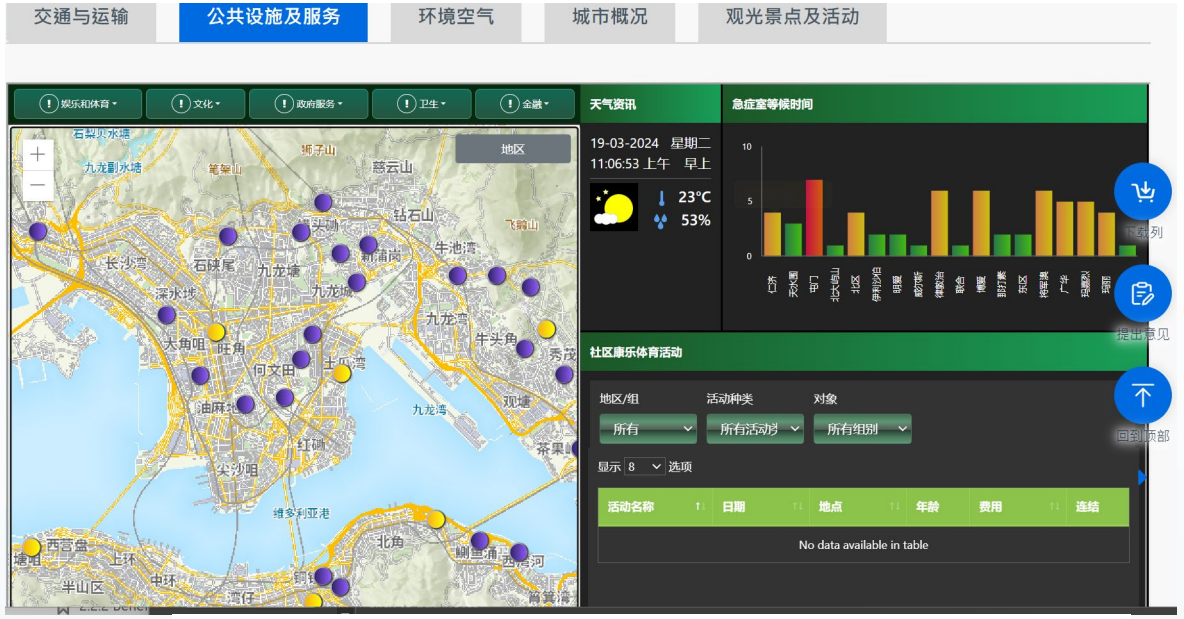
Table 1
Examples of open data platforms/projects in the transportation domain worldwide.

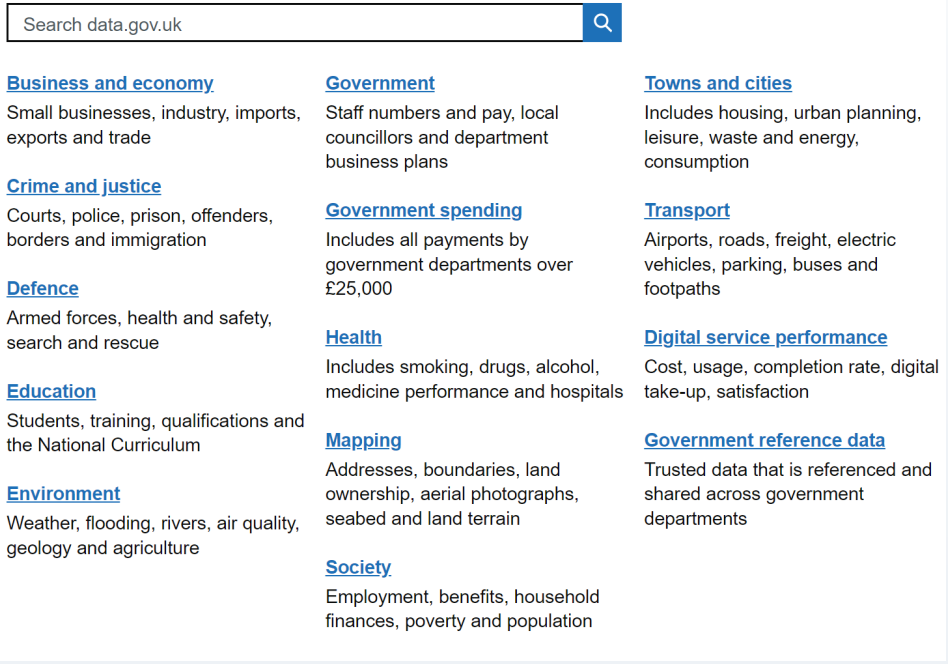
Open data platform	Country/ Area	Platform owner	Data description	Primary roles
The Intelligent Mobility Data Hub	UK	Catapult Transport Systems (company)	Detailed mapping grids, vehicle emissions, national roadworks data, mobile network data, traffic movement patterns, haulage journeys.	Store, analyze and process large volumes of transport-related data, and provide transport solutions.
Transport for London's portal	UK	Transport for London (government)	Air quality, tube, bus, coach and river, cycling, walking, planning.	Provide transport datasets for potential service developers.
Open transport data on the European Data Portal	Europe	European Commission (government)	Over 7600 datasets related to transport (e.g., bicycle hiring systems in Switzerland and Italy, road work in Belgium, the winter traffic conditions for cars in France, and datasets about road construction in Sweden)	Publish or harvest the data from different institutions within their countries and support open data use cases, such as Saemes and Moovit.
Digital Government Strategy	USA	U.S. Department of Transportation (government)	Over 2000 datasets regarding transportation.	Publish a list of publicly available data sets, and enrich, expand, and open the data inventory.
Brazilian Open Data Portal	Brazil	The Secretariat of Information Technology, Ministry of Planning, Development and Management (government)	Publish data by government agencies regarding various topics of public administration.	Promote dialogue between actors in society and with the government to think about the best use of data, promoting positive impacts from the social and economic points of view.
UAE official Open Data Portal	UAE	UAE Federal Competitiveness and Statistics Authority (government)	Data sets in economy, education, society, technology, transportation, environment, government, health and infrastructure.	Provide enhanced open data systems for public use and enhance sustainable communities based on participation and transparency.
Transport Open Data Portal	China	Ministry of Transport of China (government)	Datasets about public transportation routes, stations, flights, and road work.	Publish and provide open datasets.
Transport Open Data Hub	Australia	Transport for New South Wales (state government)		Act as a showcase for innovation from the use of transport data and provide information about data, APIs and a community forum for app developers.
Egypt Data Portal	Egypt	Egypt Government (government)	Datasets in agriculture, education, health, transport, investment, population, etc., including census data and geolocation data.	Publish datasets in various domains and support sustainable development.

(Sources: https://ts.catapult.org.uk/innovation-centre/imdh/; https://blog.tfl.gov.uk/category/open-data/; https://www.europeandataportal.eu/en/highlights/open-transport-data-european-data-portal; www.transportation.gov/data; https://dados.gov.br/; http://data.bayanat.ae/en_GB/group; http://www.mot.gov.cn/sjkf/; http://data.nsw.gov.au/data/organization/transport-for-nsw; https://egypt.opendataforafrica.org/.)

Examples of open government data platforms

https://opendata.sz.gov.cn/
https://data.gov.hk
https://www.data.gov.uk/





Can we make a ODP for CAV open data? (Conceptualization)

Intuitive concerns

Which data can be made open?

- A key premise

How to persuade the data ‘owners’ to open the data? (Who are the ‘owners’?)

- Identifying stakeholders
- A cost-benefit view

Who owns the platform?

- A critical discussion

Research questions

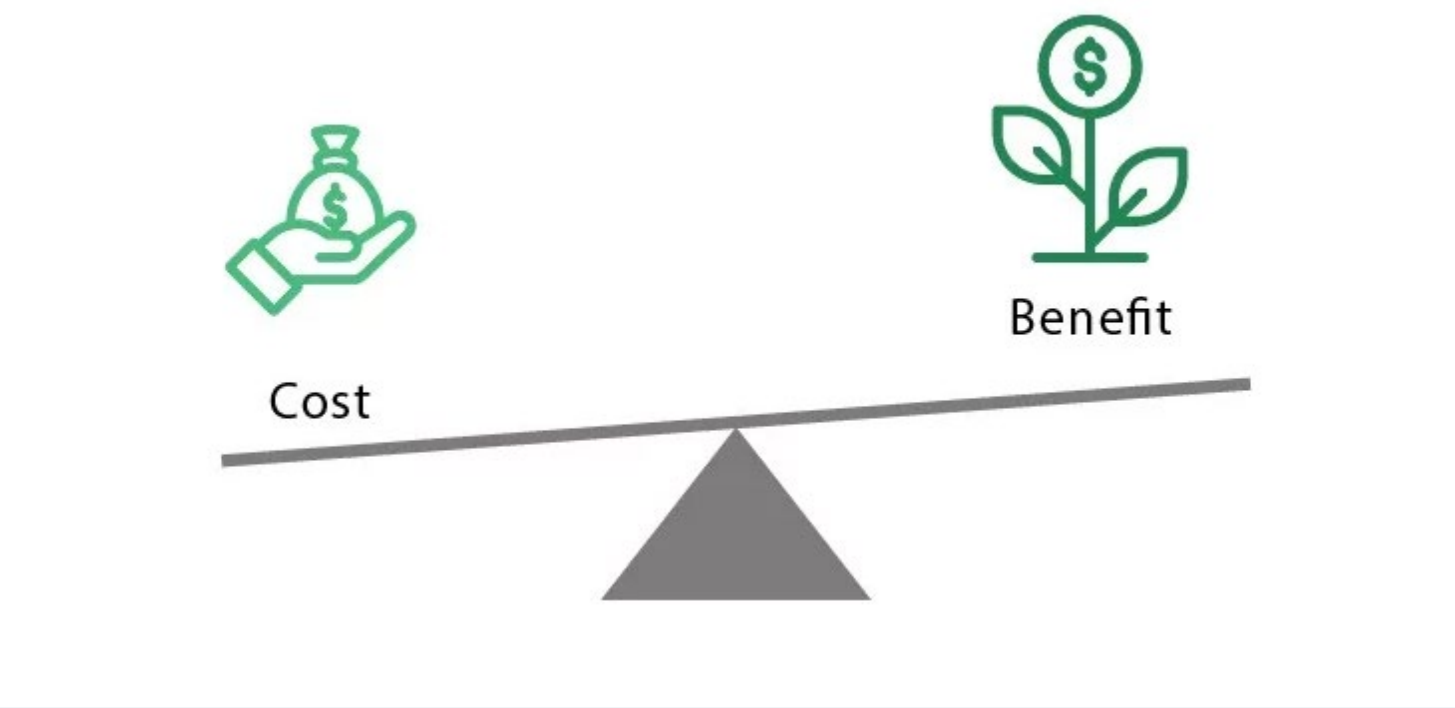
Who are the (potential) stakeholders of a CAV-ODP, delineating their purposes, interests, and roles?

What are the key processes of establishing and operating of a government-owned CAV-ODP?

What specific roles should be undertaken by the government in a CAV-ODP?

Benefits and challenges of making some CAV data open

all steps of establishing the platform…



economic, social, ecological…

Different stakeholders (including the public)

Conceptualization

innovation platform functional architecture (Bonina and Eaton, 2020)

A combined view of stakeholders and operational steps

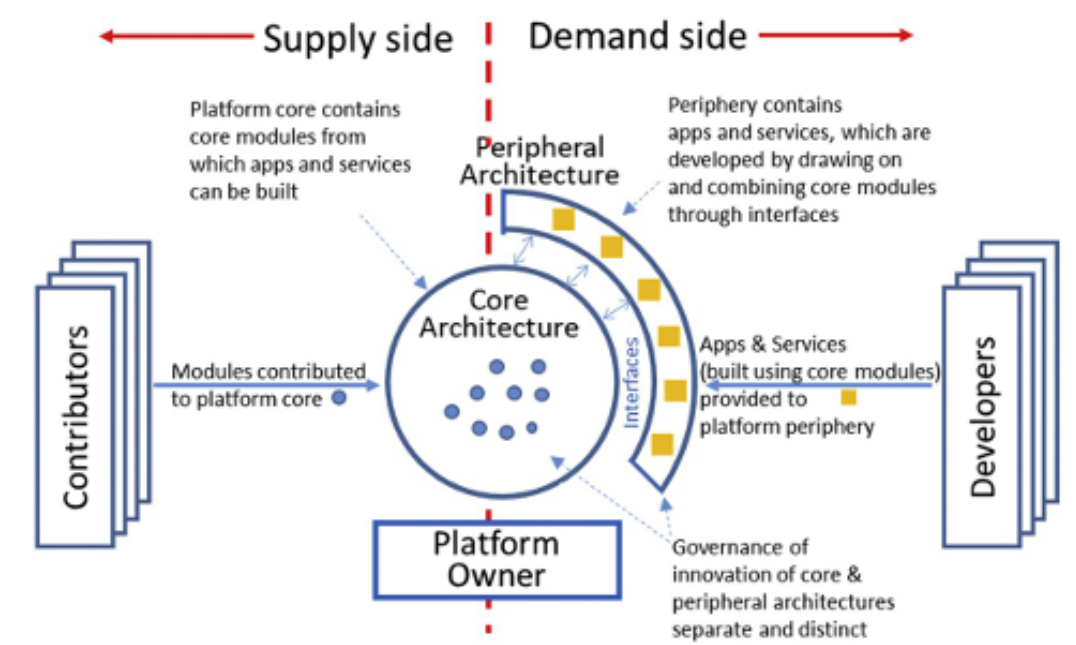


Fig. 1. Overview of innovation platform functional architecture.

(Bonina and Eaton, 2020)

CAV-ODPs: an effort to connect CAV open data and ODPs

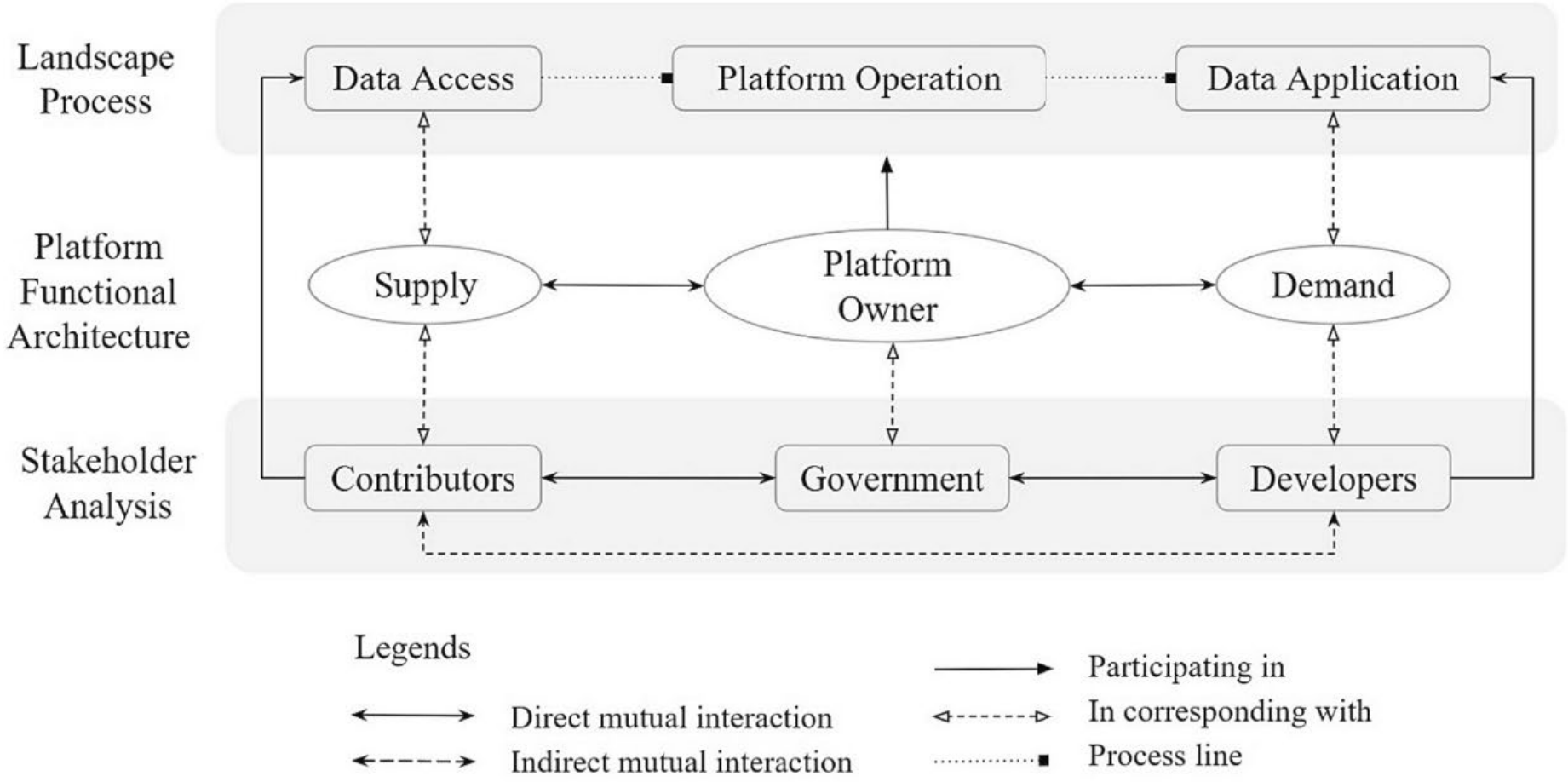


Fig. 2. Conceptual framework.
(Source: Authors. Based on Bonina & Eaton, 2020.)

Data collection

Primary and secondary data sources

Table B1. Interview records
(Source: Authors. Based on sources listed in the table.)

Interviewee	Topic	Summary of the interviewee's idea
a. Director and co-leader of an investment bank	CAV open data platform investment	The question of investing in an open data platform is to find a very niche area in which people can make profits. We have been hearing about how useful or beneficial an open data can be, but few companies can really create profit from it. An example of a government-led open data platform is the project of Copenhagen. After constructing an open data platform, 5 apps have been developed, for different uses all relating to transport, for buses, for taxis, for trains, for hiring bikes, for car renting on weekends. Despite bringing some benefits, the users' experience was not good. Users have to download all 5 apps in order to meet different needs, which brings inconvenience. And once there is a failure of one app, people will lose trust in them all. That might be a problem when start-ups come into being using transport open data.
b. Business Manager of a self-driving company	Advantages of CAVs and their datasets	What makes an autonomous car called autonomous rather than automated is that it can make a decision based on what it sees. For example, an automated call will approach an obstacle, and stops. An autonomous car will see it, and think about what obstacle that is and whether it is safe to continue or not. There are loads of data sets on autonomous vehicles. The vehicles generate many types of data, including visual data, telemetry data, lidar data, and location data. It's the implementation of the data that makes a difference. It is what you use them for and how you think that might be useful for your vehicle that matters. We leave that up to our end users. We develop our products using our own data sets.
c. A Researcher at a transportation laboratory	Research value of CAV data	During the process of experimenting, huge amounts of data could be generated, such as experiment documents and outcome. the public have the access to these experiment data." There are not any databases, however, but they are free, open to anyone, able to be found on the Internet. Apart from scientific researches, commercial companies can make use of these data if they want, although there have not been so many commercial applications, indeed.
d. A professor on transportation policies	Potential challenges of government-led CAV-ODPs	I'm not convinced national governments are really committed to open data. I don't think they want to really put so much pressure on companies. However, I think there is more penitence and emphasis on this at the local level. For example, Oxford is very keen on having open data from the companies willing to share. All the agreements between local government and companies are voluntary, meaning to say that if the companies don't comply, there is very little what the government can do. I think that's a very problematic situation that should be changed.

Supplementary data online
https://doi.org/10.1016/j.cities.2024.104918

Data collection

Table A1. Data sources of the process landscape and stakeholder analysis (Source: Authors. Based on sources listed in the table.)

Source	Type of data	Interviewee/Title/URL/Source	Content
Interview (First-handed)	CAV open data applications and challenges	Director and co-leader of an investment bank	CAV open data platform investment
		Business Manager of a self-driving company	Advantages of CAVs and their datasets
		A researcher at a transportation laboratory	Research value of CAV data
		A professor of transportation policies	Potential challenges of the government-led CAV-ODP
Literature	CAV application	Identifying and prioritizing the benefits and concerns of connected and autonomous vehicles: A comparison of individual and expert perceptions	CAV application
		Connected and Automated Transport: Research and Innovation Capacity in Europe	CAV application
		Recent advances in connected and automated vehicles	CAV development
	CAV data application	Reflections and recommendations on policies related to automated maps	Applications of CAV open data in enhancing safety
		Governing autonomous vehicles: emerging responses for safety, liability, privacy, cybersecurity, and industry risks	Applications of CAV and CAV data
		A discussion of the need for market-based applications of motor vehicle and driver data	Applications of vehicle data
		The value of intelligent driving big data based on trusted computing in the insurance sector	CAV open data application in insurance
		Connected automated vehicles and insurance: Analyzing future market structure from a business ecosystem perspective	CAV open data application in insurance
		A data-driven approach to characterize the impact of connected and autonomous vehicles on traffic flow	Applications of CAV open data in transportation domains
		Future urban transport technology development and innovation	CAV open data application in urban infrastructure management
		Identification and optimization of Xi'an city center system based on open data	CAV open data application in urban planning
		MapX: An open geospatial platform to manage, analyze and visualize data on natural resources and the environment	CAV open data application in natural resources management
		Impact of intelligent transport on urban space	Positive effect of CAV open data on sharing spirits and working efficiency
	Open data platform establishment and management	Research on key technologies of data platform for automated driving	Steps involved in CAV data platform establishment
		Research on value-added services for government open data platforms based on top-level design	Government open data platform design
		The impacts of open data initiatives on smart cities: A framework for evaluation and monitoring	Open data application in smart cities
		Cultivating open government data platform ecosystems through governance: Lessons from Buenos Aires, Mexico City and Montevideo	Open data platform design & governance
Government reports	CAV open data applications	Connected and Autonomous Vehicles in Europe: The Challenges with Using the Data They Generate	Challenges of CAV data application
		Industry characteristics and value chain analysis of open data exploitation	Establishing a open data application platform
		Blockchain-Based Data Sharing and Trading Model for the Connected Car	CAV open data design adopting blockchain
		TRADING: Traffic Aware Data Offloading for Big Data Enabled Intelligent Transportation System	Transportation open data application
		Freeway Traffic Speed Estimation of Mixed Traffic Using Data from Connected and Autonomous Vehicles with a Low Penetration Rate	Applications of CAV open data in transportation domains
		Internet of Vehicles in Big Data Era	Relationship between vehicles and data
		Open data for democracy: Developing a theoretical framework for open data use	Positive effect of open data on democratic processes
		How to Ensure the Economic Viability of an Open Data Platform	Open data platform design & governance
		Open data platforms: Discussing alternative knowledge epistemologies	Open government data platform cases &studies
		Connecting societal issues, users and data. Scenario-based design of open data platforms	Open data platform design under different circumstances
		Towards European Open Science Commons: The EGI Open Data Platform and The EGI DataHub	An open data platform case
		Connected and Automated Vehicles (CAV): Open Data Recommendations (Austroads,2018)	Applications of CAV open data
		Research and innovation in smart mobility and services in Europe: An assessment based on the Transport Research and Innovation Monitoring and Information System (TRIMIS)	Applications of CAV open data in transportation domains
		Use of Data from Connected and Automated Vehicles for Travel Demand Modeling	Applications of CAV open data in transportation domains
		Connected and Autonomous Vehicles: Transport for London, 2019	Development plans regarding CAV
		Planning for Connected and Automated Vehicles Report	CAV's impact
		ITE Statement on Connected and Automated Vehicles	CAV application
Industry reports	(CAV) Open data application	Open data: Unlocking innovation and performance with liquid information	Open data application in general
		Smart Mobility and Open Data: A Global and Personal Perspective	Business cases using CAV open data
		World Bank Support for Open Data (2012-2017)	Positive effect of open data on public service efficiency
		Waymo Open Dataset available for autonomous vehicle researchers	Classifications of CAV data by hardware
		SMMT: Connected and Autonomous Vehicles: Position Paper	Applications of CAV and CAV data

Country
Europe
China
UK, China
USA
China
Netherlands
France
USA, Singapore, Spain, Russia, Bahrain, Saudi Arabia and United Arab Emirates, Chile, Sweden, Finland, China, German, Brazil, South Korea
Netherlands
Europe
Australia
Europe
USA
UK
USA
USA
Global (McKinsey)
UK, USA
Global developing countries (World Bank)
USA
UK, USA

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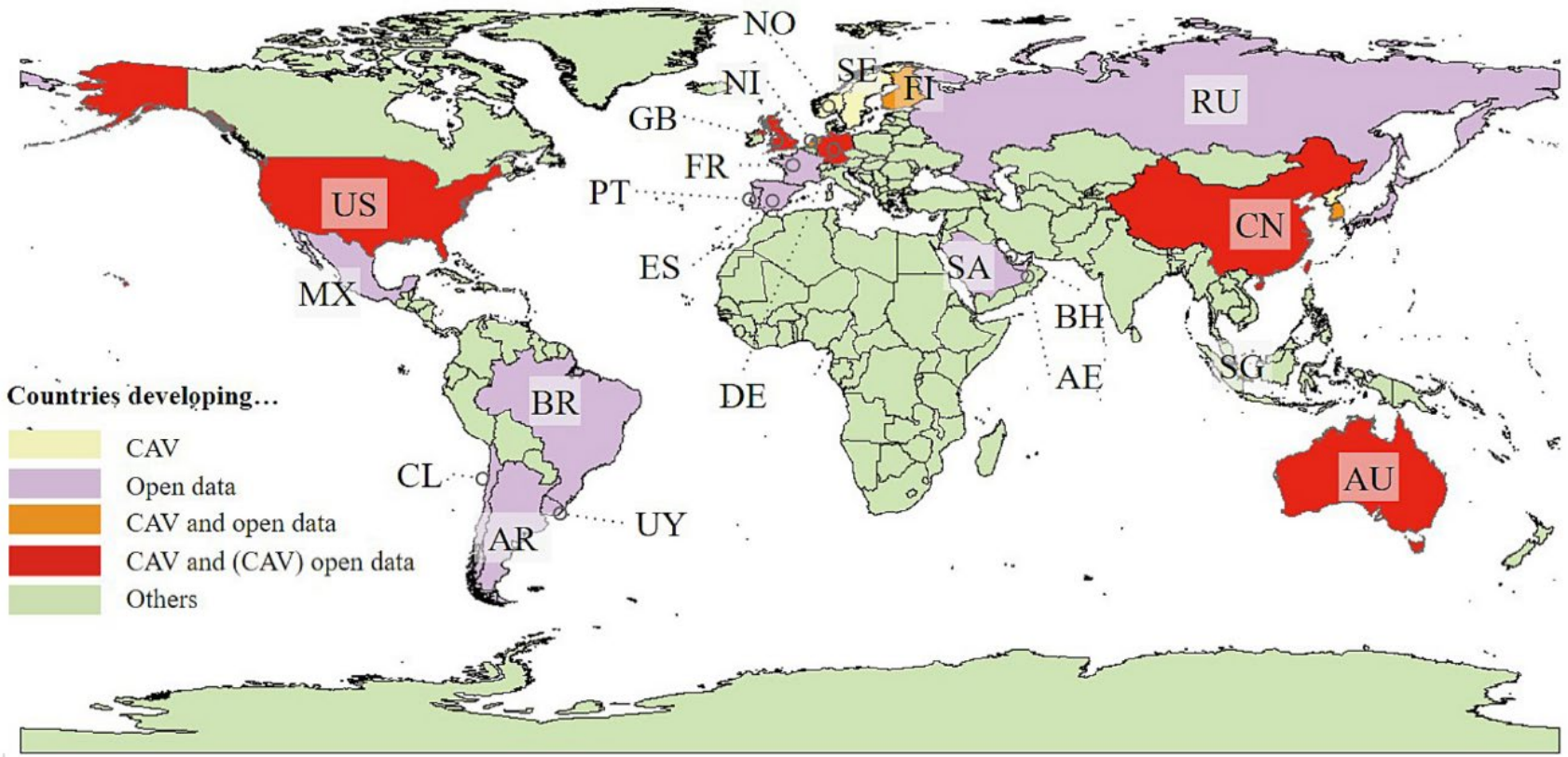
Data collection



AE-United Arab Emirates	CL-Chile	FR-France	NL-Netherlands	SG-Singapore
AR-Argentina	CN-China	CB-United Kingdom	NO-Norway	SE-Sweden
AU-Australia	DE-Germany	JP-Japan	PT-Portugal	US-United States
BH-Bahrain	ES-Spain	KR-South Korea	RU-Russia	UY-Uruguay

Results

Steps to build a CAV-ODP

1. CAV data access
2. Platform operation
3. CAV open data application

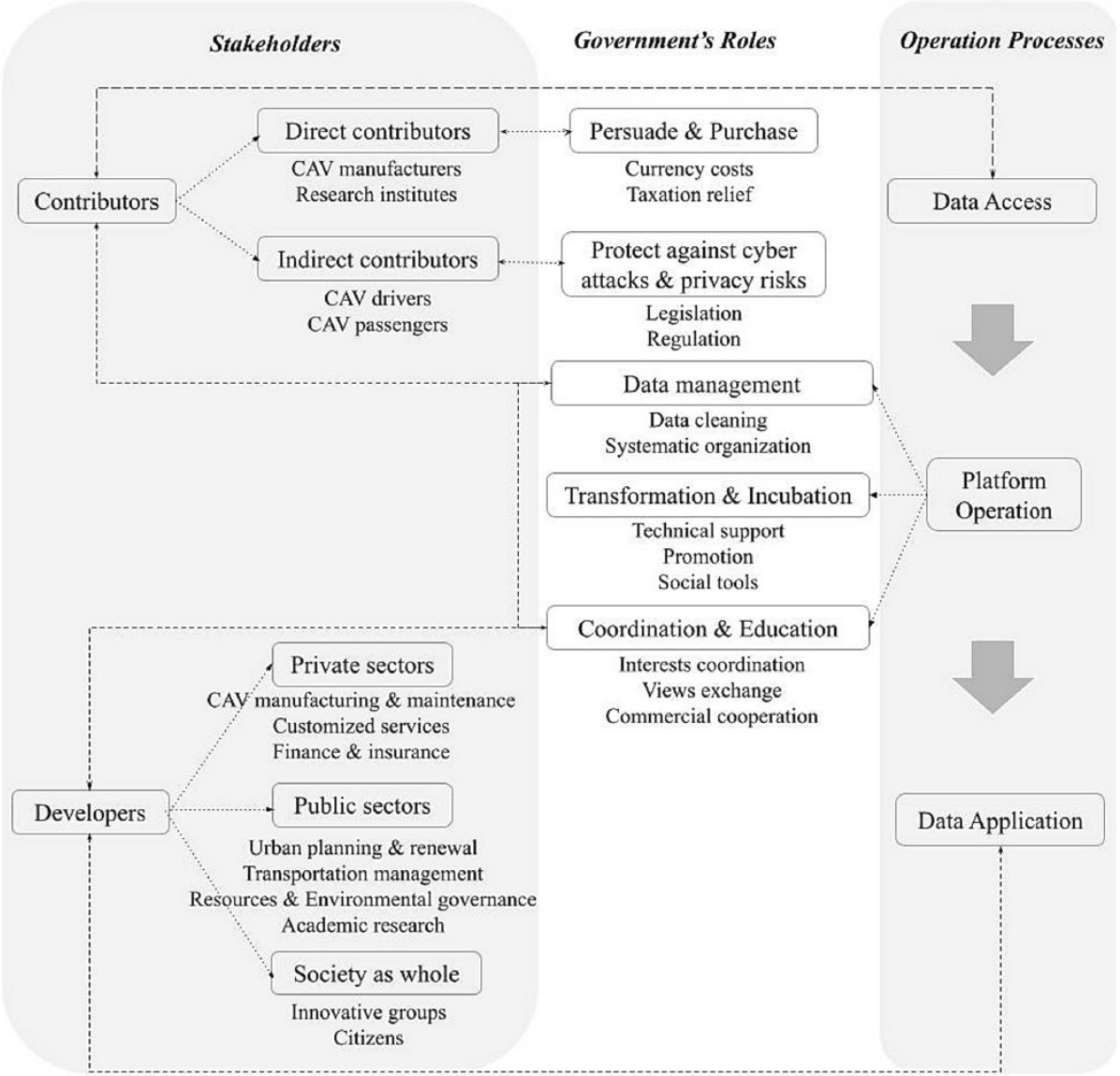


Fig. 3. Stakeholders, operation processes, and governments' roles in a CAV-ODP.
(Source: Authors.)

1. CAV data access: a view of different contributors

Direct contributors: research institutes and companies

- ‘persuade and purchase’ strategy
- tax cut, subsidy
- benefits of data sharing

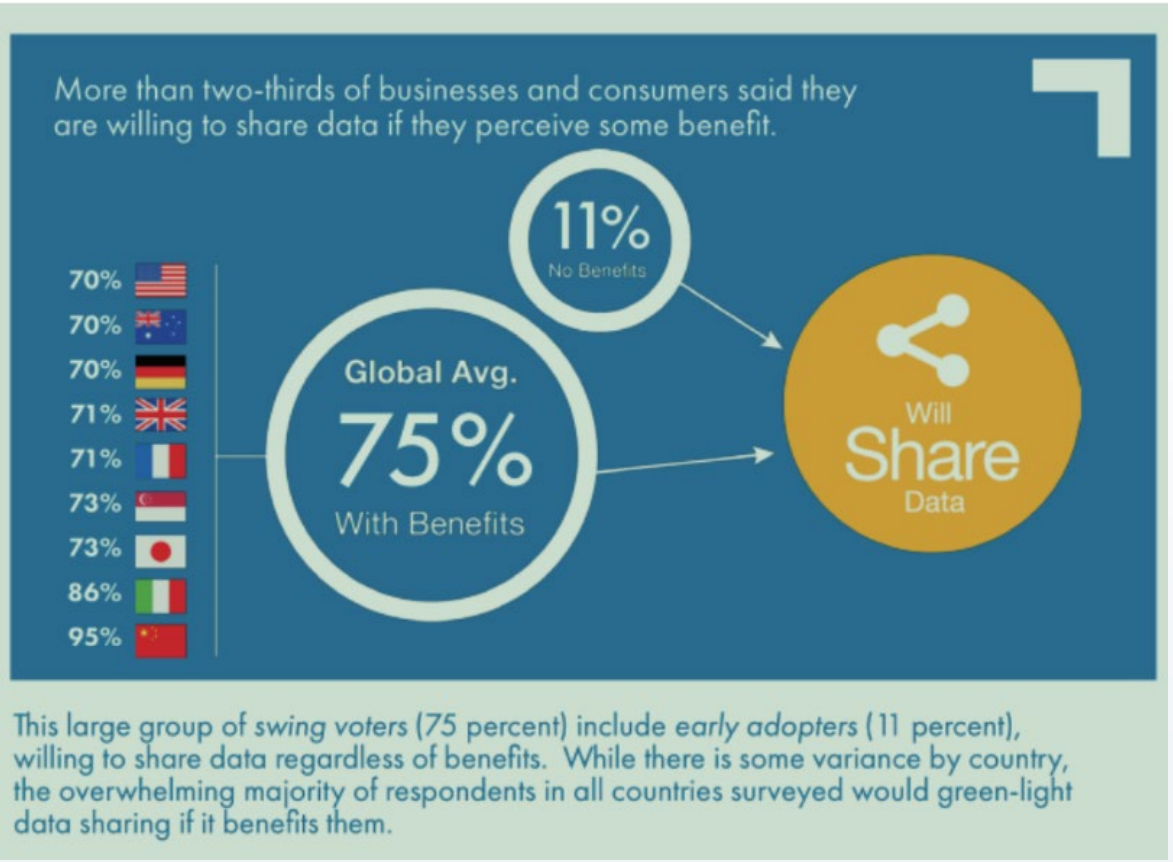
Indirect contributors: individual

- cyber-attacks and privacy leaks
- accountability

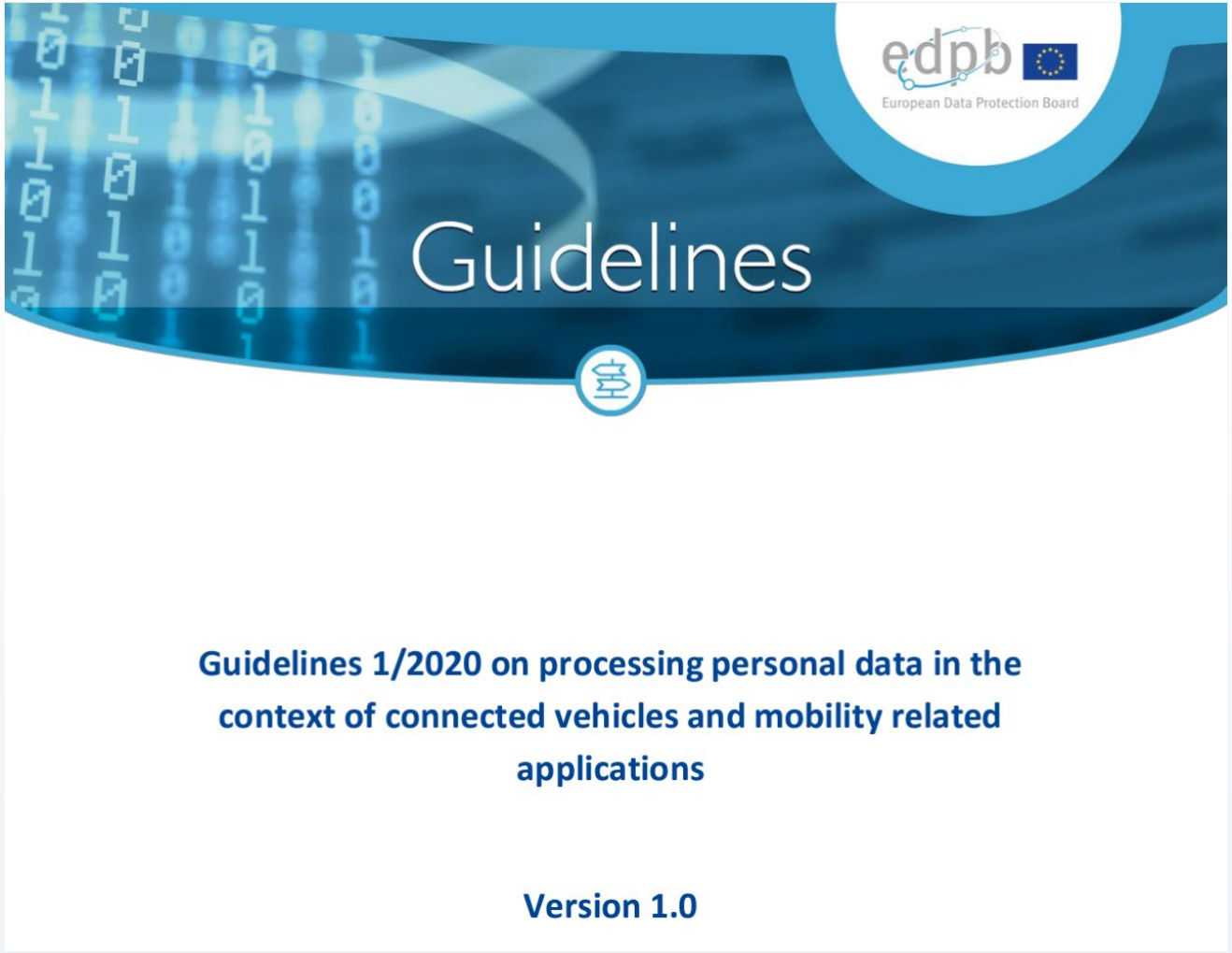
Table 3
Sources of CAV-related open data around the world.

Type of Institute	Number	Examples
Research institutes	20	NCLT Dataset: The University of Michigan North
Self-driving companies	7	Waymo Open Dataset
Government departments	0	–

(Source: Authors. Based on information in Appendix C.)



Global Identity and Fraud Report (Experian, 2019)



https://www.edpb.europa.eu/sites/default/files/consultation/edpb_guidelines_202001_connectedvehicles.pdf

2. From access to application: platform operation

CAV data management

data cleaning, reclassification, and integration
storage, mining, and analytics

large volume, variety, speed
formats, languages, consistency, geographical barriers…

Transformation and incubation

Technical: programming interface (API), graphical user interface (GUI), web portals, Cloud sites

Social: events, hackathons, exhibitions, competitions, incubators

Outcomes: new products and services

Coordination and education

Coordinating data contributors and developers

Arousing public awareness

technical communication, commercial cooperation, interest coordination, and views exchange

2. From access to application: platform operation

Hu et al., 2022

CAV data management

Contents lists available at ScienceDirect

Transportation Research Part C

journal homepage: www.elsevier.com/locate/trc

Processing, assessing, and enhancing the Waymo autonomous vehicle open dataset for driving behavior research

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[a] School of Civil Engineering, The University of Queensland, Australia
[b] Department of Traffic Engineering, Tongji University, China
[c] Civil and Environmental Engineering, University of Massachusetts, Lowell, United States

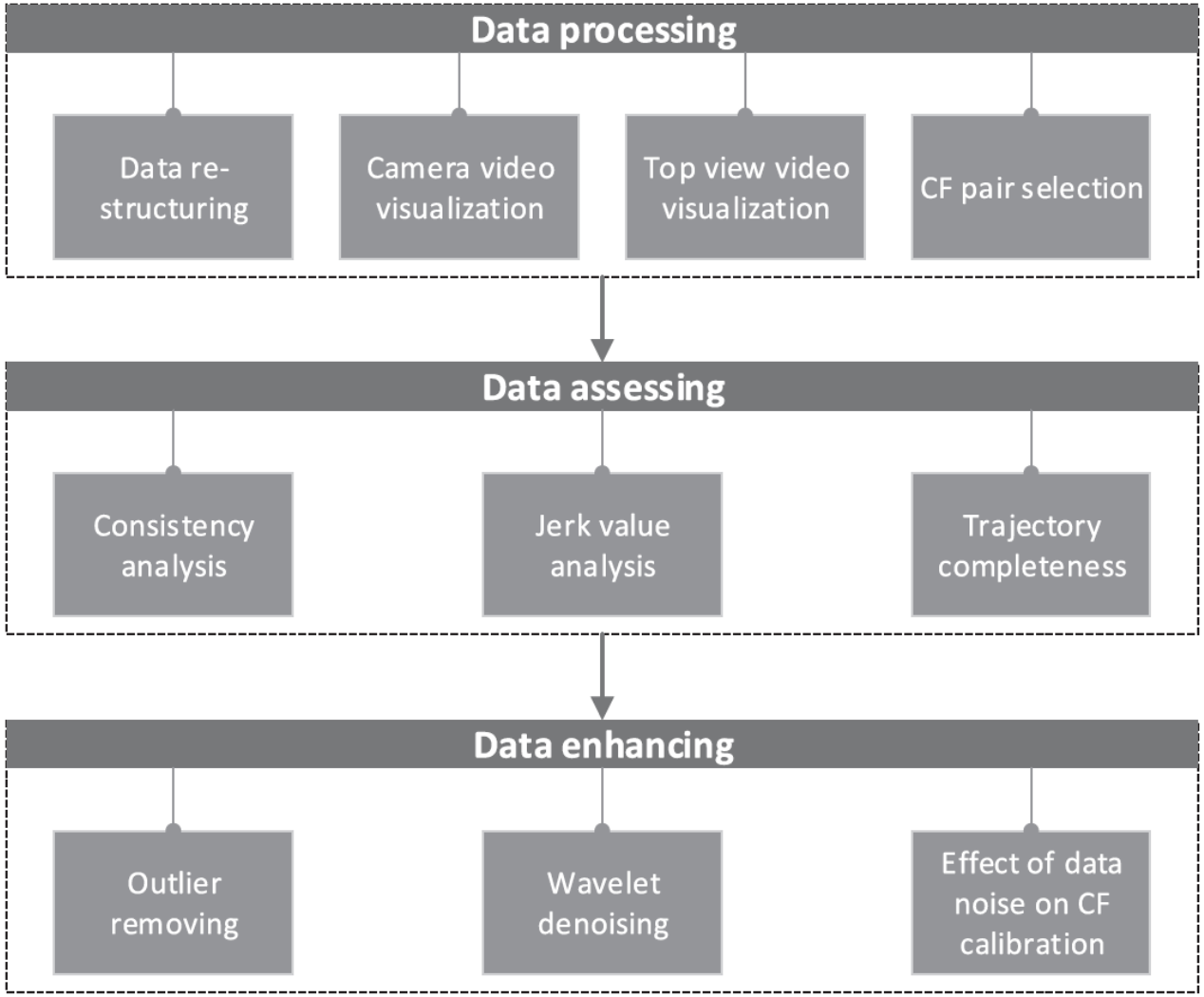


Fig. 1. Flow chart of the data processing, assessing and enhancing procedure; CF: car following.

2. From access to application: platform operation

Transformation and incubation

Coordination and education

MAR
24
2024

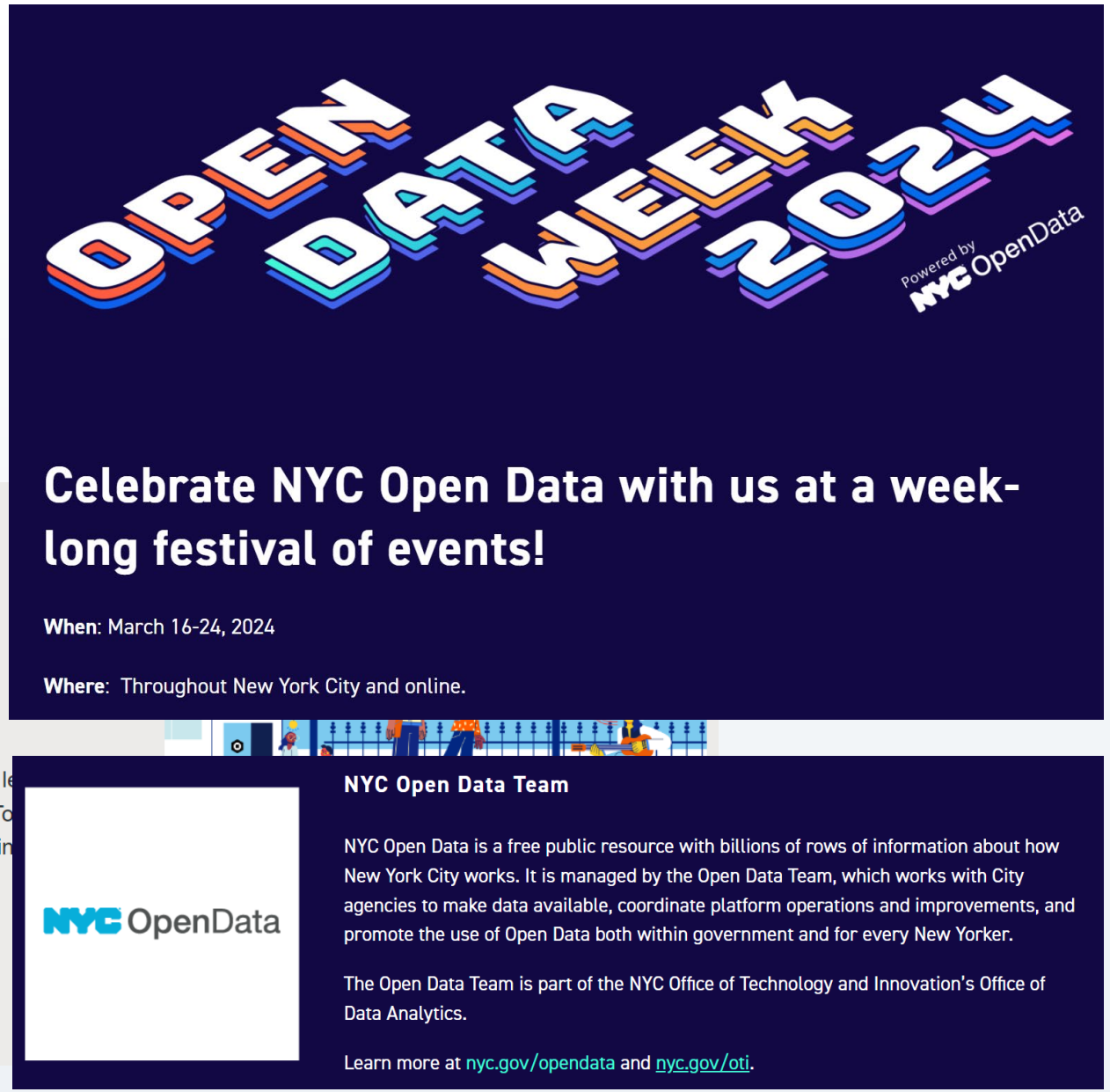
March 24 @ 2:00 pm - 3:00 pm

East Village Walking Tour: Explore NYC's invisible digital city

Lower East Side Playground 400 East 12th Street, New York

Uncover the unseen parts of Manhattan's East Village through a 45-minute walking tour l
Helpful Places in partnership with Sarah Batchu, a nonprofit leader and public servant. To
we will explore open datasets, smart cities infrastructure, and other urban gems hidden in
sight. After the 45-minute walk we'll settle into a nearby coffeeshop […]

Free



https://2024.open-data.nyc

2. From access to application: platform operation

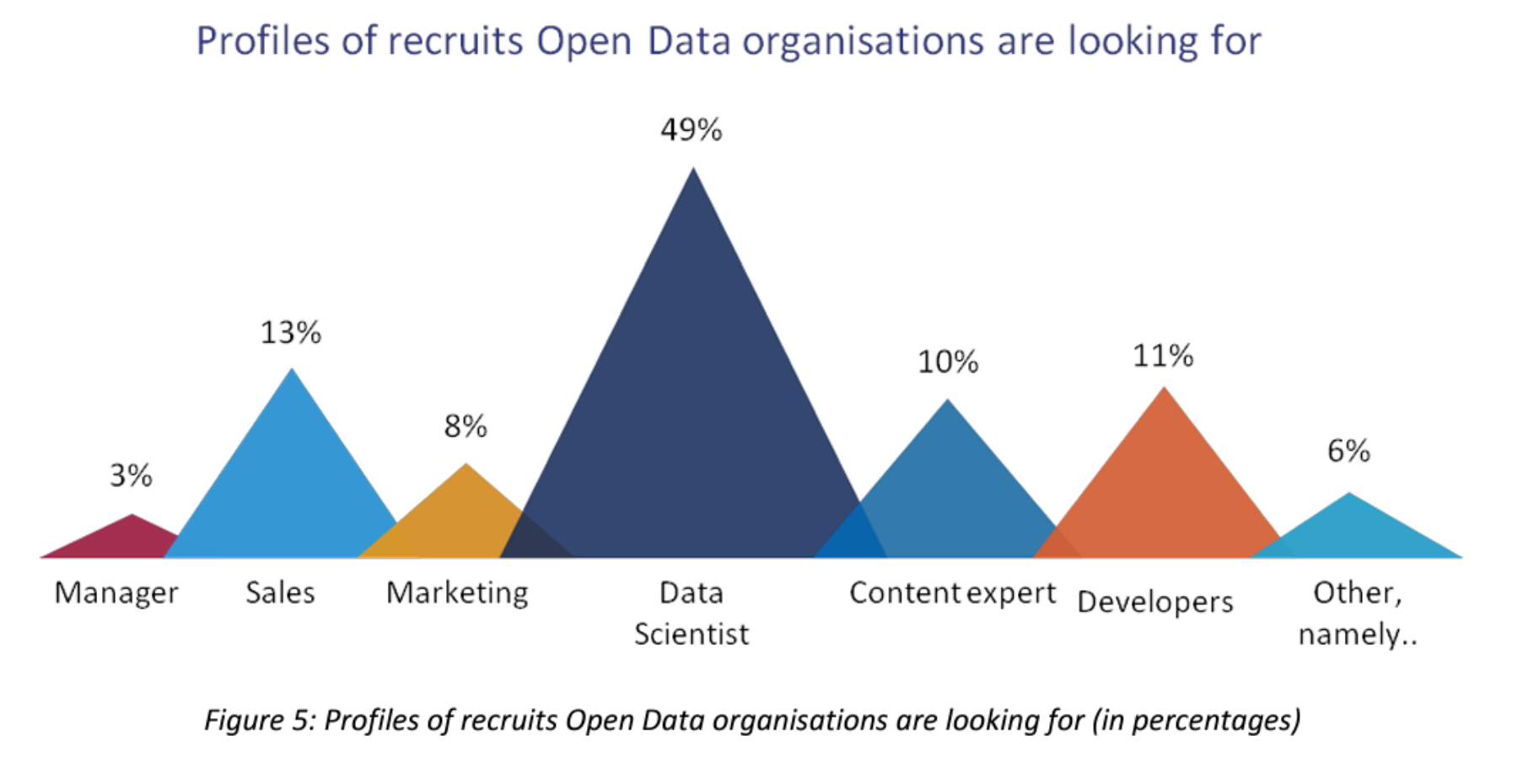


Figure 5: Profiles of recruits Open Data organisations are looking for (in percentages)

Berends J., Carrara W., Engbers W., Vollers H. (2020)

3. CAV open data application

3.1 The private sector

3.2 The public sector

3.3 Society as a whole

3. CAV open data application

3.1 The private sector

CAV manufacturers

Customized services/products

Consulting

Finance

insurance model estimation

Small and young enterprises can benefit more (Berends et al., 2020).

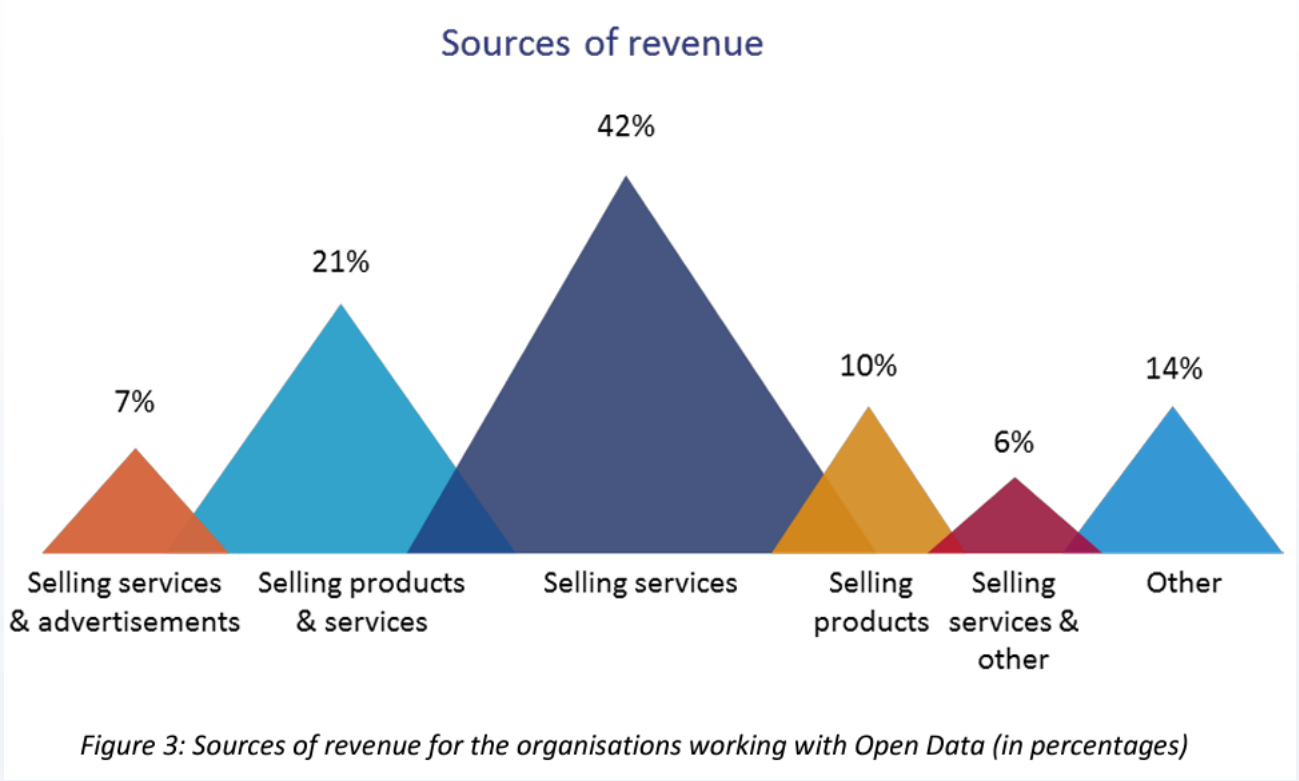


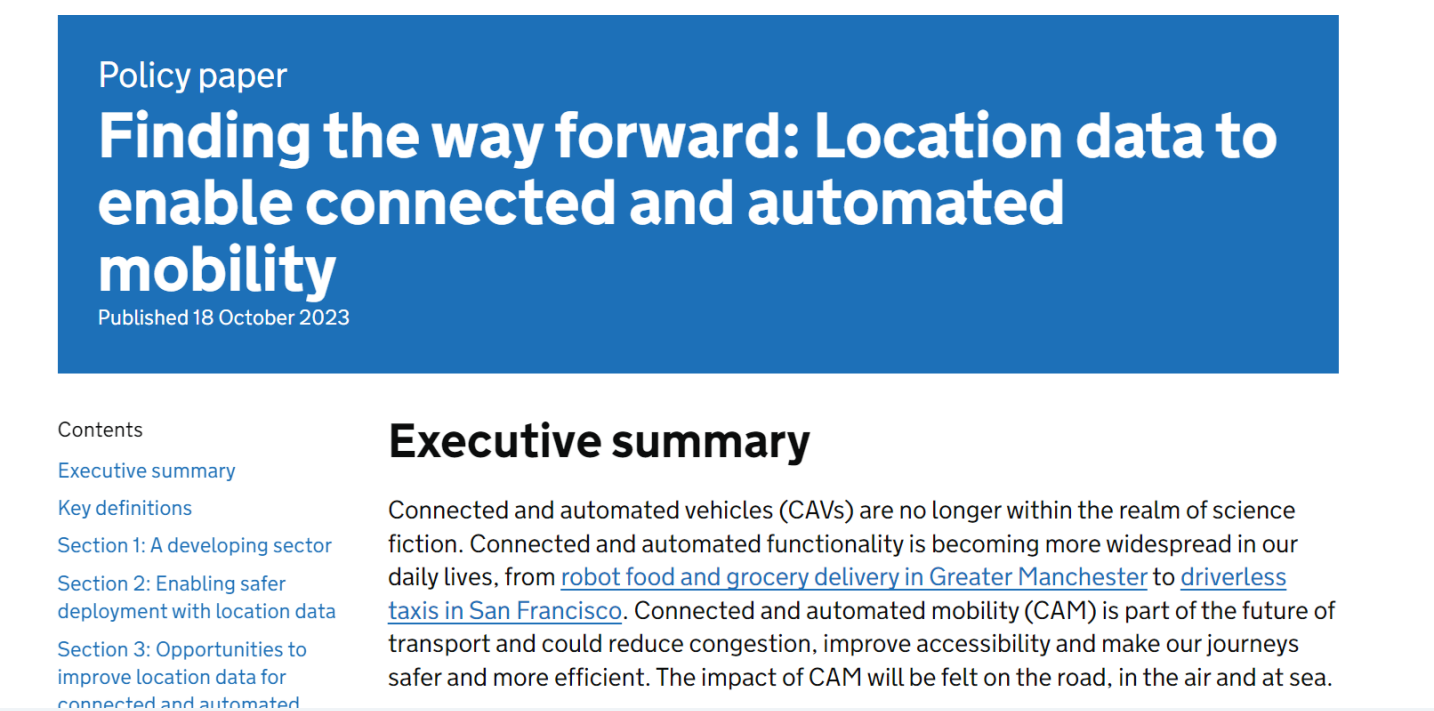
Figure 3: Sources of revenue for the organisations working with Open Data (in percentages)

Berends J., Carrara W., Engbers W., Vollers H. (2020)

3. CAV open data application

3.1 The private sector

CAV manufacturers



Policy paper

Finding the way forward: Location data to enable connected and automated mobility

Published 18 October 2023

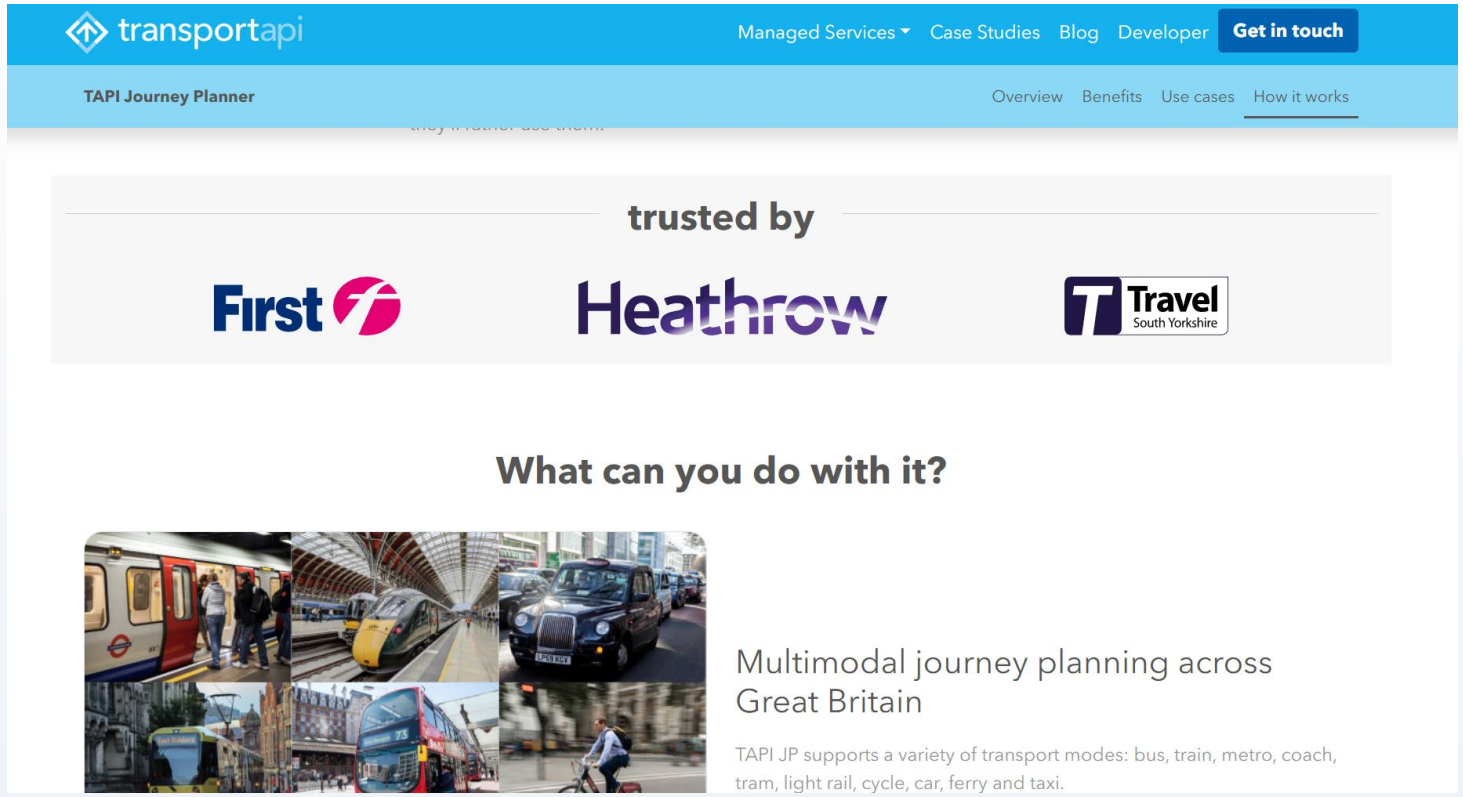
Contents

Executive summary

Connected and automated vehicles (CAVs) are no longer within the realm of science fiction. Connected and automated functionality is becoming more widespread in our daily lives, from robot food and grocery delivery in Greater Manchester to driverless taxis in San Francisco. Connected and automated mobility (CAM) is part of the future of transport and could reduce congestion, improve accessibility and make our journeys safer and more efficient. The impact of CAM will be felt on the road, in the air and at sea.

This report highlights the role location data and location technologies will have in the safe deployment of CAM at scale on the UK's roads.
https://www.gov.uk/government/publications

Data-as-a-service (DaaS)



TransportAPI, a *Data-as-a-Service* portal offered by Placr Ltd., provides a comprehensive UK transport data catalogue (https://www.transportapi.com)

3. CAV open data application

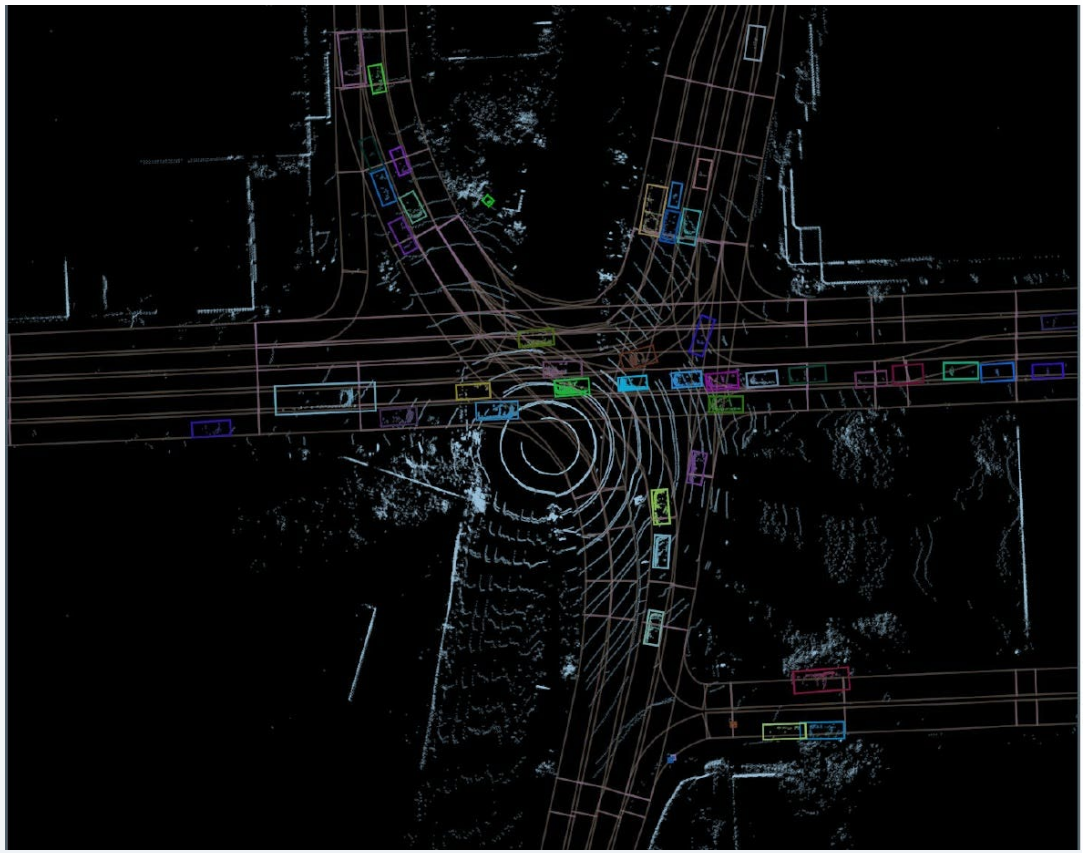
3.2 The public sector

CAVs offer *real-time* vehicle, road, and environmental data for decision-making.

The ODP *fuses* data from multiple sources to form a complete regional picture.

Urban and transport planning policymaking	Mapping natural resources and monitoring environmental risks	Academia
Identifying dilapidated construction Route planning Car parking	Mountain fire, pollution, temperature, humidity… Carbon emission monitor	Behavioural Health Commuting patterns

Transport planning



https://www.forbes.com/sites/samabuelsamid/2019/06/19/argo-ai-and-waymo-release-automated-driving-data-sets/?sh=59f294a81d00

Large Car-following Data Based on Lyft level-5 Open Dataset: Following Autonomous Vehicles vs. Human-driven Vehicles

Guopeng Li[1,*], Yiru Jiao[1], Victor L. Knoop[1], Simeon C. Calvert[1], and J.W.C. van Lint[1]

***Abstract*— Car-Following (CF), as a fundamental driving behaviour, has significant influences on the safety and efficiency of traffic flow. Investigating how human drivers react differently when following autonomous vs. human-driven vehicles (HV) is thus critical for mixed traffic flow. Research in this field can be expedited with trajectory datasets collected by Autonomous Vehicles (AVs). However, trajectories collected by AVs are noisy and not readily applicable for studying CF behaviour. This paper extracts and enhances two categories of CF data, HV-following-AV (H-A) and HV-following-HV (H-H), from the open Lyft level-5 dataset. First, CF pairs are selected based on specific rules. Next, the quality of raw data is assessed by anomaly analysis. Then, the raw CF data is corrected and enhanced via motion planning, Kalman filtering, and wavelet denoising. As a result, 29k+ H-A and 42k+ H-H car-following segments are obtained, with a total driving distance of 150k+ km. A diversity assessment shows that the processed data cover complete CF regimes for calibrating CF models. This open and ready-to-use dataset provides the opportunity to investigate the CF behaviours of following AVs vs. HVs from real-world data. It can further facilitate studies on exploring the impact of AVs on mixed urban traffic.**

***Index Terms*— Car-following, trajectory dataset, autonomous vehicle, driving behaviour**

or seemingly-real AV in different scenarios [8–10]. Similar experiments can also be carried out in a virtual environment by using driving simulators [11]. Field tests and simulations are controllable so researchers can focus on specific points of interest. However, due to cost limitations, these two approaches cannot provide comprehensive and large data covering diverse scenarios.

Recently, the release of autonomous driving datasets, such as Waymo [12], nuScenes [13], and Lyft5 [14], has enabled researchers to study AVs' impacts on traffic with real-world data. Hu et al. [15] offer the first attempt to process a CF dataset from the Waymo dataset. However, because AVs are not marked in the entire dataset of Waymo, only 274 HV-following-AV (H-A) pairs and 1032 HV-following-HV (H-H) pairs are extracted. The limited amount of samples leads to contradictory findings. For example, Wen et al. [16] conclude that, compared with H-H, H-A has lower driving volatility, smaller time headways, and higher Time-to-Collision (TTC); while Hu et al. [17] found no significant difference between H-H and H-A, except for smaller spacing during congestion. To reduce the biases when using small datasets, a larger and


Tube Heartbeat
Visualising London's pulse with HERE
Post
Like 94
Share
5am 8am 11am 2pm 5pm 8pm 11pm
II Pause
17:15-17:30
Dataset
Older (2012)
Latest (2015)
See the change
Show
Line changes
Station changes
Both
Jump to
Choose...
Bakerloo
Central
Circle
District
Hammersmith & City
Jubilee
Metropolitan
Northern
Piccadilly
Victoria
Waterloo & City
Arriving: 270692
Leaving: 222408
Interchanging: 122050
Total Journeys: 9907629
Greenford
Northolt
Wembley
Neasden and Stonebridge
Kilburn
Childs Hill
Stoke Newington
Clapton
Hackney
Upton
Manor Park
Ilford
Wanstead Flats
Park
Ladbroke Grove
Maida Vale
Acton
Hanwell
Brent Valley Golf Course
Shepherd's Bush
Chiswick
Chiswick House
Brentford
Isleworth
Hounslow
Barnes
Mortlake
Richmond
Sheen Common
Roehampton
Whitton
Putney Heath
Richmond Park
Wandsworth
Battersea
Battersea Park
Camberwell
Peckham
New Cross
Deptford
Greenwich
Isle of Dogs
Canning Town
Limehouse
Woolwich
Charlton
Plumstead
Blackheath
Shooters Hill
Lewisham
Brockley
Kidbrooke
Eltham
Grove Park
Brixton
East Dulwich
Herne Hill
Wandsworth Common
Ravensbourne River
Barking Creek
River Thames
About
Key
2 km
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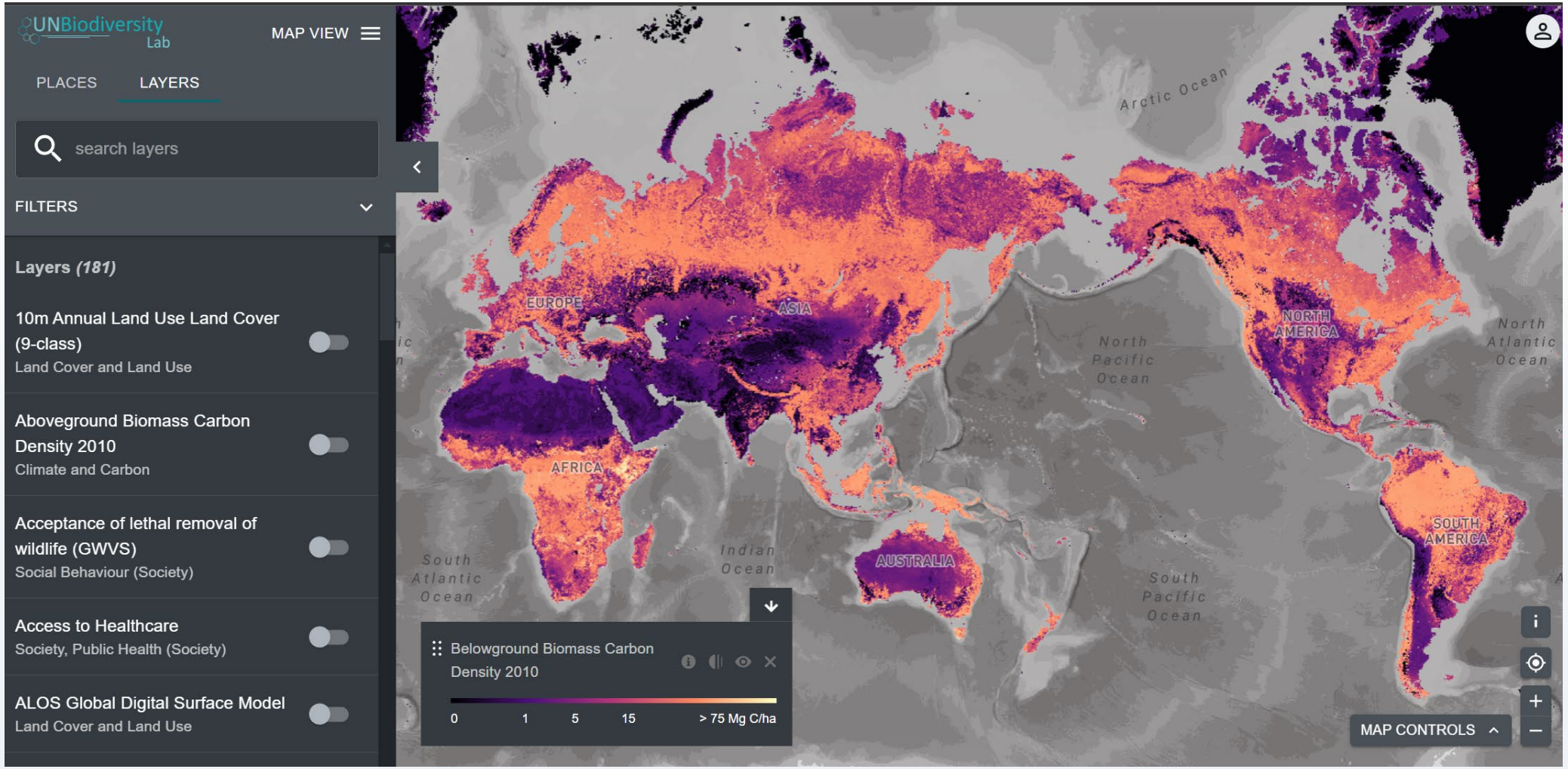
Natural resources



UN-biodiversity MapX

3. CAV open data application

3.3 Society as a whole

An individual's role is not only a consumer but also an engaged *citizen* (Milakis & Müller, 2021)

Enhancing public service efficiency and transparence.

Boosting sharing, innovation, and start-up urbanism.

CAV-ODP as an educational platform of emerging technologies: from acceptance to proactive participation.

Critical reflections

Why government?

A cost-benefit view

- Externalities of CAV data application
- Internalising costs
- Maximising and sharing indirect benefits
- Overcoming the ‘anti-common tragedy’

from a technology-centric view of CAVs to a holistic approach to governance

Bringing platform capitalism and smart urbanism in dialogue

The private sector participation in data-generating platforms

- tech-giants fear?
- 'black box' of decision making
- lacking accountability
- disconnects platforms from place-based responsibilities
- a rising 'platform logic' (capital + tech)

The public sector in smart cities

- social monitoring and control?
- top-down oversight of urban systems
- 'smart cities' ending up as real estate construction

Emerging technology and data may change power dynamics.
Be careful.

Challenges

Privacy and security

Unexpected new categories of data generated

Cross-jurisdictional social impacts and inequalities (Caprotti et al., 2022): uneven global development and latecomers

European Commission

English

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Shaping Europe's digital future

Home | Policies | Activities | News | Library | Funding | Calendar | Consultations | AI Office

Home > Policies > AI Act

AI Act

The AI Act is the first-ever legal framework on AI, which addresses the risks of AI and positions Europe to play a leading role globally.

The AI Act aims to provide AI developers and deployers with clear requirements and obligations regarding specific uses of AI. At the same time, the regulation seeks to reduce administrative and financial burdens for business, in particular small and medium-sized enterprises (SMEs).

The AI Act is part of a wider package of policy measures to support the development of trustworthy AI, which also includes the AI Innovation Package and the Coordinated Plan on AI. Together, these measures will guarantee the safety and fundamental rights of people and businesses when it comes to AI. They will also strengthen uptake, investment and innovation in AI across the EU.

The AI Act is the first-ever comprehensive legal framework on AI worldwide. The aim of the new rules is to foster trustworthy AI in Europe and beyond, by ensuring that AI systems respect

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Quicl

Important milestones

February 2024 — European AI Office

January 2024 — AI innovation package to support Artificial Intelligence startups and SMEs

December 2023 — Political agreement on the AI Act reached by the co-legislators

June 2023 — European Parliament's negotiating position on AI Act

December 2022 — General approach of the Council on AI Act

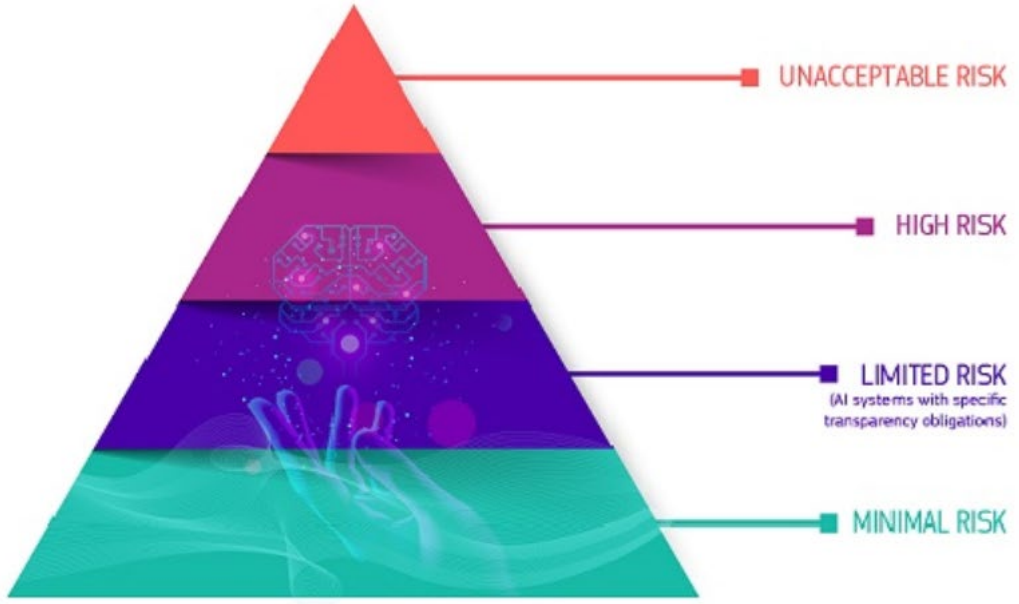
September 2022 — Proposal for an AI liability directive

June 2022 — Launch of first AI regulatory sandbox in Spain: Bringing the AI Regulation forward

https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence

A risk-based approach

The Regulatory Framework defines 4 levels of risk for AI systems:



All AI systems considered a clear threat to the safety, livelihoods and rights of people will be banned, from social scoring by governments to toys using voice assistance that encourages dangerous behaviour.

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Thank you