

# Holo in the value chain of autonomous vehicles

Ruter dialogue conference  
Oslo  
June 13th 2022



# Holo has extensive and unique operational experience from implementing and operating different projects across the Nordic countries since 2018



Passenger  
vehicles

**Being planned**

**In operation**

**Completed**



**Unannounced (2022)**  
*Passenger vehicles*



**Slagelse Hospital**  
*Passenger vehicles*



**Gothenburg - Chalmers University**  
*Passenger vehicles*



**Gothenburg - Lindholmen phase 1**  
*Passenger vehicles*



**Køge - SUH Køge Hospital (indoors)**  
*Passenger vehicles*



**Helsinki - Aurinkolahti**  
*Passenger vehicles*



**Tallinn - Sohjoa Baltic**  
*Passenger vehicles*



**Oslo - Akershusstranda / Kongens Gate / Ormøya**  
*Passenger vehicles*



**Aalborg - Aalborg East**  
*Passenger vehicles*



**Oslo - Ski**  
*Passenger vehicles*



**Copenhagen - Nordhavn**  
*Passenger vehicles*

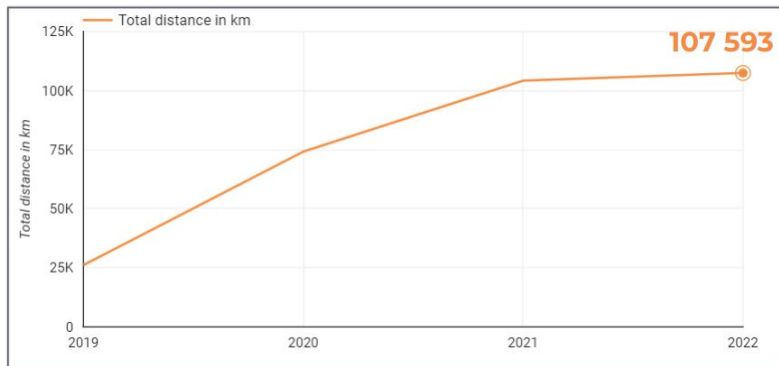
# The work done from 2016 to 2022 has given Holo unique experience with autonomous vehicles in the Nordic countries

Holo has deployed projects across the Nordic countries - often as the first or one of the first companies



Holo has worked with Naveya (primarily) and Sensible 4 to try and achieve level 4 autonomy (no safety driver)

Holo has done much more than pilot projects - driving many months and many kilometers in all kinds of conditions



# Holo can help in multiple ways to make an autonomous system work



## **Implementation partner and operator of autonomous systems**

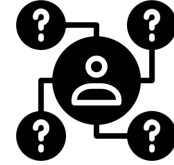
Covering all aspects of implementation (hardware, software, processes) and different segments (air, ground, passengers, freight).



## **System integrator and provider of software platform for operating and supporting autonomous vehicles.**

Holo is not building the autonomous software itself, but all the components to integrate an autonomous system into existing systems and processes.

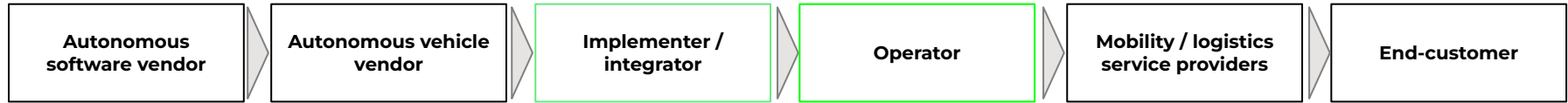
Holo is building software from the unique perspective of an autonomous operator - ensuring that real requirements are met.



## **Consultancy and expert input on autonomous systems**

Defining projects, aligning stakeholders, calculating business cases, finding vendors - all Holo's knowledge can be accessed as individual services

# Holo's role is becoming increasingly important - as autonomous software and vehicles mature, they need to be implemented and operated



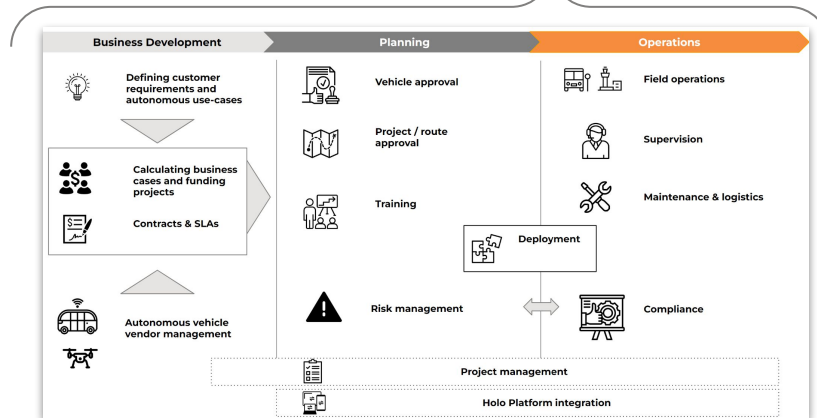
Responsible for early pilot projects - but will struggle to scale, expand geographically and manage local relationships to mobility providers and authorities outside of their core geography

Increased competition drives focus on core product of software or hardware - leading to a focus on partnering with a company like Holo for integration and operation.

See breakdown below.

Holo believes that operation of autonomous vehicles will be fundamentally different from operating manually operated vehicles

It will resemble software implementation and software testing more than traditional operations and current operators will struggle to realise benefits without assistance.



These tasks are sometimes covered by the vehicle or software vendor in projects. But as the industry matures, these tasks will increasingly be covered by a more specialised company, as the technology becomes easier to use and the role of the operator becomes more like an integrator of different components.

Holo expects to be able to keep reducing the cost to deliver these tasks through standardisation.

# Holo's has core competencies across the value chain of autonomous mobility projects

More at <https://www.letsholo.com/services>

## Business Development



Defining customer requirements and autonomous use-cases



Calculating business cases and funding projects



Contracts & SLAs



Autonomous vehicle vendor selection



## Planning



Vehicle approval



Project / route approval



Training



Risk management



Project management



Holo Platform integration

## Operations



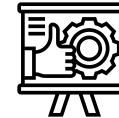
Field operations



Supervision



Maintenance & logistics



Compliance

# Building a “route catalogue” to match customers of autonomous mobility and vendors of autonomous vehicles and software



Defining customer requirements and autonomous use-cases

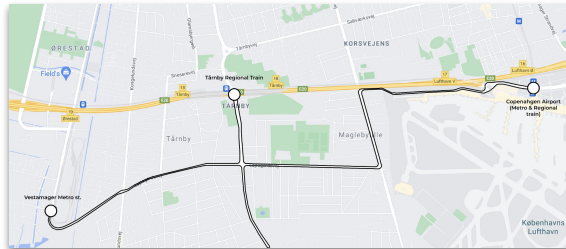
Collecting information about potential locations for future autonomous mobility from municipalities, harbours, hospitals, PTAs, office parks etc.:

1. Transportation needs
2. Weather conditions
3. Service level required
4. Operational requirements
5. Road/network specifications
6. Integrations

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	-1.3 °C (29.7) °F	-1 °C (30.1) °F	0.1 °C (32.3) °F	3 °C (37.5) °F	6.4 °C (43.4) °F	9.9 °C (49.8) °F	11.6 °C (53) °F	10.8 °C (51.4) °F	7.9 °C (46.3) °F	3.9 °C (39.1) °F	1 °C (33.7) °F	-1.2 °C (29.9) °F
Min. Temperature °C (°F)	-3.6 °C (25.5) °F	-3.5 °C (25.8) °F	-2.5 °C (27.5) °F	0 °C (32.1) °F	3.1 °C (37.5) °F	6.8 °C (44.3) °F	8.7 °C (47.6) °F	8.1 °C (46.5) °F	5.7 °C (42.2) °F	1.9 °C (35.4) °F	-1 °C (30.3) °F	-3.5 °C (25.6) °F
Max. Temperature °C (°F)	0.9 °C (33.6) °F	1.2 °C (34.2) °F	2.6 °C (36.8) °F	5.8 °C (42.4) °F	9.3 °C (48.8) °F	12.7 °C (54.8) °F	14.4 °C (57.9) °F	13.5 °C (56.2) °F	10.2 °C (50.4) °F	6 °C (42.7) °F	2.8 °C (37) °F	1 °C (33.9) °F
Precipitation / Rainfall mm (in)	131 (5.2)	129 (5.1)	122 (4.8)	98 (3.9)	90 (3.5)	76 (3)	85 (3.3)	102 (4)	132 (5.2)	118 (4.6)	120 (4.7)	133 (5.2)
Humidity(%)	84%	80%	79%	76%	73%	75%	78%	81%	83%	84%	83%	85%
Rainy days (d)	13	13	13	12	11	11	11	11	13	12	12	13



Holo  
Template - TOM  
Holo Ground  
Route Catalogue



# Holo can help select the right vehicle vendor, vehicle and autonomous software



**Autonomous vehicle vendor evaluation**

## Commercial

Holo knows what a good setup should cost and what a fair contract looks like

Holo knows what additional services the vehicle vendor should be able to deliver to Holo or another operator

## Hardware / vehicle

Holo knows what works in real conditions and what to look for in a vendor's solution

Holo has been a crucial partner for different vehicle vendors in homologation of vehicles in Scandinavia.

## Autonomous software

Holo knows what capabilities are the most important for the routes we are discussing with our customers

Holo know what safety features are needed for approval in Scandinavia



## Support and other processes

Holo knows what processes are needed from the vehicle vendor to support the operation of the vehicle

Holo can spot gaps in the vehicle vendor's support setup that Holo may need to fill

## Additional software and tools (API / data / mapping)

Holo know what data is needed for Holo to operate and document

Holo knows what additional tools for data management, mapping, remote control etc. are needed for Holo to support the route



# Complex project approvals in Scandinavian & Baltic countries has prepared Holo for level 4 applications in the future



Project / route approval

Holo has identified the categories below for application content, applicable across the Nordic and Baltic countries.

## Project approval: Application content

### Project descriptions and conditions

**Example of content:**

- Project scope, purpose and partners
- Operational and safety organization
- Crisis management process and tools
- Standard Operating Procedures
- Training programme
- Maintenance procedures

### Technical documentation/ application

**Example of content:**

- Essential technical requirements e.g. according to Directive 2007/46/EC
- Application for exemptions
- Registration Process

### Autonomous system documentation

**Example of content:**

- Autonomous capabilities and functionality
- Operational Design Domain
- Objects & Events Detection and Responses
- Fallback Minimal Risk Condition
- SAE level of automation
- Data recording & Data protection
- Cybersecurity

### Risk assessment

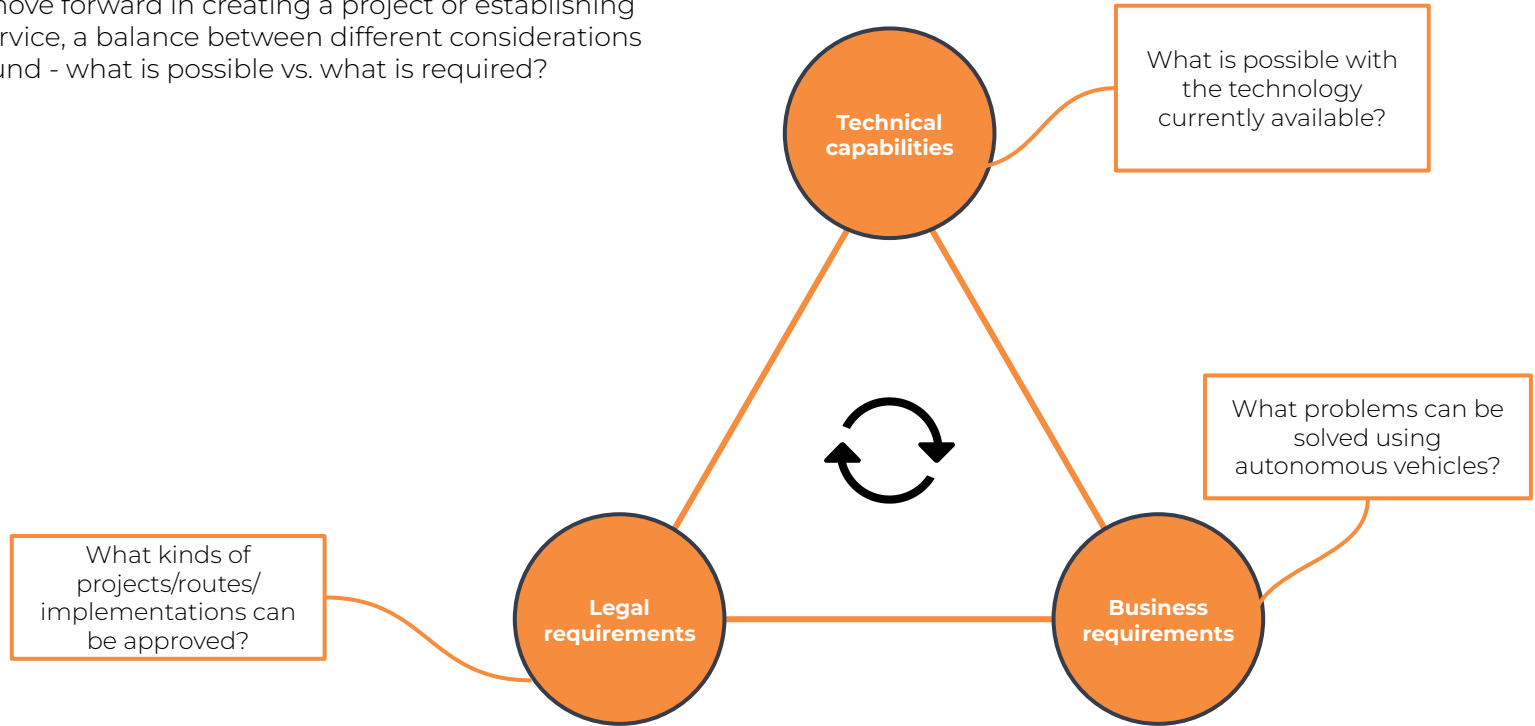
**Example of content:**

- Functional Safety assessment e.g. ISO26262
- Traffic Safety: Route assessment of the autonomous vehicle(s) impact on traffic safety on the specific route

Test, validation and maturity documentation

# Project dependencies - finding the right balance between technology, approvals and use cases

In order to move forward in creating a project or establishing a route or service, a balance between different considerations has to be found - what is possible vs. what is required?



# Based on experience from completed projects Holo can calculate business cases for autonomous projects accurately



Calculating  
business cases  
and funding  
projects

## Business Development

### Key questions

What are the customers requirements?

Is there a defined budget?

Has additional external funding been considered?

### Major cost drivers

- Complexity of route
- Customer service requirements (uptime)
- Driving with safety drivers

## Vehicle vendor mgmt.

### Key questions

What is the vehicle vendor's price of providing the vehicle and the supporting services?

### Major cost drivers

- Autonomous software licenses
- Implementation cost - vendor experts
- Vehicle acquisition or leasing cost

## Planning

### Key questions

What is the price of getting the vehicle and route approved?

### Major cost drivers

- Vendor's quality of safety documentation
- Vendor's quality of safety testing
- Application processing time with authorities

## Operations

### Key questions

What is the day-to-day operational setup? (operational hours etc.)

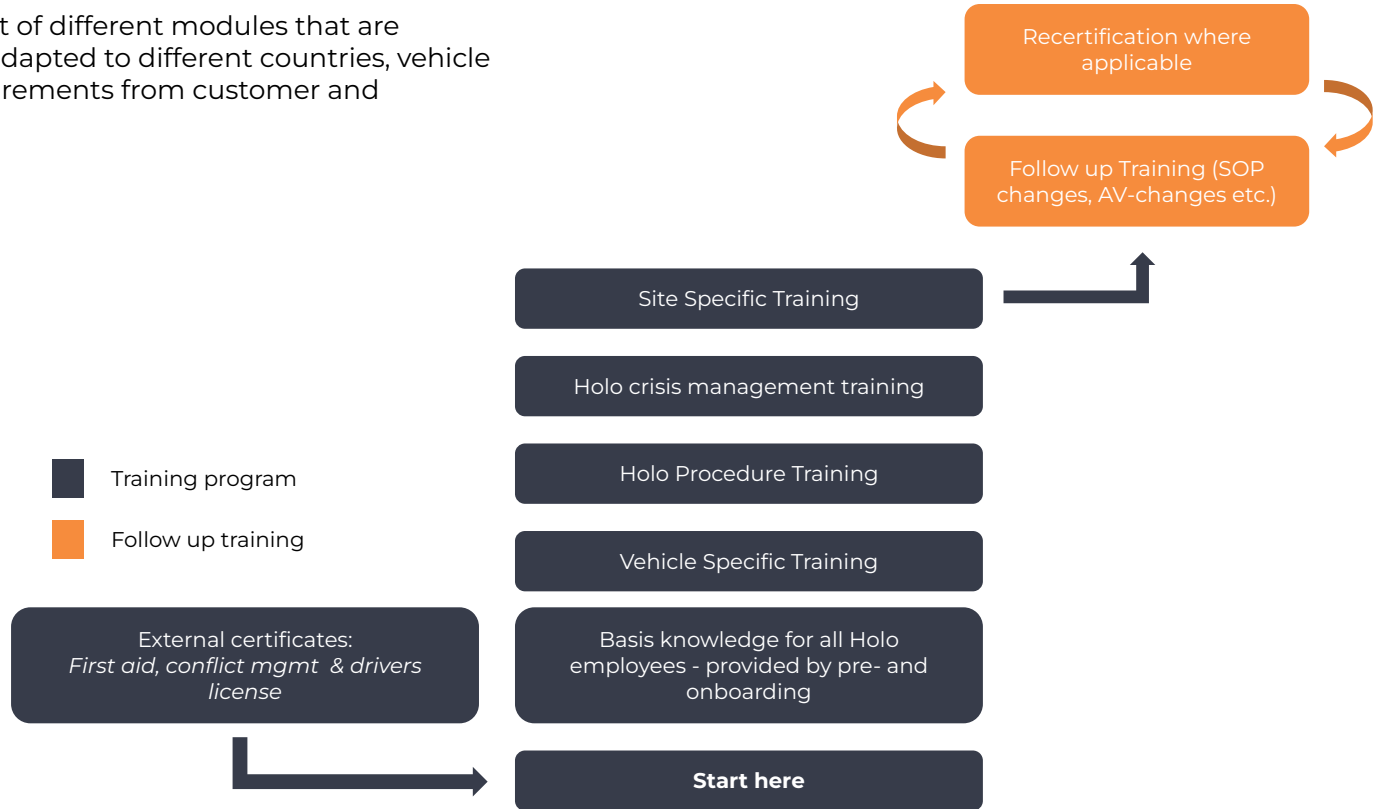
### Major cost drivers

- Salary cost for safety drivers
- Salary cost for Supervision
- Overhead cost of system integration
- Typical maintenance cost per kilometer (spare parts and maintenance time)

# Holo has conducted training for the operation of autonomous vehicles for multiple clients



The training program consist of different modules that are continually developed and adapted to different countries, vehicle vendors and changing requirements from customer and authorities



# Holo Supervision has been developed to cover all aspects of autonomous operations



## Supervision

### Monitoring

- Vehicle performance
- Vehicle data
- In-vehicle data
  - *Issue counting*
  - *Passenger counting*
  - *Other equipment*



### Troubleshooting

- Supporting safety drivers
- Escalating to vehicle vendor
- Issue logging with vendor
- Log file analysis
- Creating support tickets



### Feature requests (Vendor)

- Autonomous software feature requests
- Vehicle hardware feature requests
- Vendor process improvement suggestions
- Vendor API improvement suggestions



### Incident management

- Communication with emergency personnel
- Incident data collection
- Incident people management



### Operational reporting

- Creating dashboards
- Uptime reporting
- Performance analysis
- Reports to customers and authorities (daily/weekly/monthly)



### Remote control / assistance

- Remote control of autonomous vehicles
- Assistance in decision-making for autonomous vehicles



### Route scheduling

- Defining and adjusting timetables
- Communication of delays, cancellations and updates



### Shift scheduling

- Safety driver shift planning
- Back-up shift planning
- Maintenance shift planning
- Managing absences and illness



### Maintenance control

- Daily maintenance / inspections / cleaning
- Logging of mechanical issues
- Scheduling maintenance (planned, preventive and reactive)



# Holo typically plays a central role in autonomous projects, managing various stakeholders and coordinating information flows



**Project management**

In some projects Holo has the responsibility for supporting the mobility end-user with typical customer support

Mobility end-user

Authorities

In all previous projects Holo has been responsible to the authority application and the subsequent follow-up with the local authorities

In some projects Holo will work with the local PTA to coordinate the end-user experience, collect data and exchange experience.

Mobility provider

Holo

Dispatch management vendor

In projects with an on-demand component Holo has either integrated with the dispatch management vendor or worked closely with them to integrate processes

In all previous projects Holo has managed the relationship to the vehicle vendor, identifying issues and providing feedback on hardware and software.

Vehicle vendor

Other project partners

Holo is typically responsible for managing many additional stakeholders, like researchers, road maintenance departments, garage providers, media, local politicians etc.

# Holo is building a custom platform that makes it possible to quickly create integrated setups for different projects

## User interfaces



End-user app  
(iOS / Android)



Follow site  
[follow.letsholo.com](https://follow.letsholo.com)



Operator app



Operational dashboards



Supervision Portal &  
Control Panel



Remote control  
By vehicle vendor



Fleet Maintenance  
Management

## Backend

Dispatch  
management  
Licensed by Holo

?

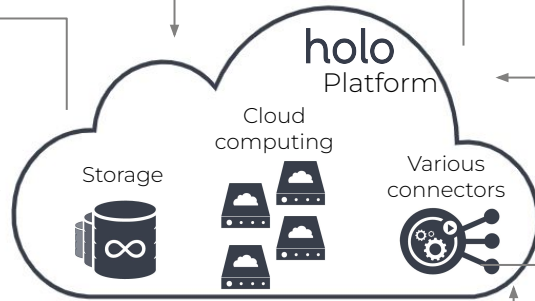
## Hardware



Data from vehicle vendor API



Sensors



## Integrations

Custom integrations



Dispatch management  
Owned by customer



Holo API consumers

Municipalities, researchers,  
infrastructure partners,  
telecom etc.

# Holo's experience in different segments means that Holo will always bring the best experience to any project

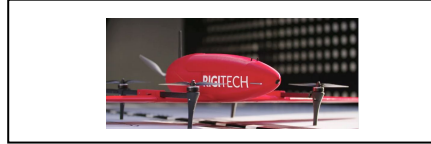
## People transportation



**Low priority** - Not currently pursuing projects - technology and market not yet mature



## Freight transportation



**High priority** - Technology available and customers willing to invest



## Other (Cameras, sensors and more)



**Medium priority** - Specialized use-cases being discussed with vendors and customers

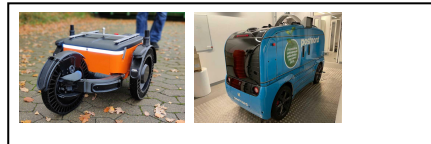


## holo Air

## holo Ground



**High priority** - Focus on selected projects with mature vendors



**High priority** - Technology available and customers interested in pilot projects



**Medium priority** - Looking for vendors and projects





# Contact

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