ISO 4448: Governing robotic passenger and goods vehicles and devices in public, pedestrianized spaces

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Thank you for inviting me to speak today.

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Likely, we are all familiar with massive factory and warehouse operations that use automated mobile robots orchestrated to move and stack parts and products for assembly or delivery.

And most of us are aware that mobile robots have been used on **farms and in mines** for many years.

Now, these robots have expanded beyond these controlled, industrial environments to enter **public, pedestrianized spaces in hospitals, restaurants, and airports** for delivery, maintenance, and surveillance.

More recently, robots have entered **less-structured municipal footways and bikeways** to deliver packages and food. To sweep streets, plough snow, pick up litter, and write parking tickets.

Robot innovation naturally moves from structured to unstructured spaces, from industrial spaces to urban living spaces.

Now on our walkways — they are just learning to crawl.

Scaled for footways and bikeways, and initially radio-operated like large toy cars, mobile robots are now being equipped with the cameras, LIDARs, communication, and intelligent software developed for the automated passenger vehicle.

Some are claiming SAE Level 3 and Level 4 driving automation capabilities.

But there is far less government oversight for the confirmation of these capabilities compared to that for driverless passenger vehicles.

Their variation, versatility and capabilities are expanding rapidly. They are evolving in parallel with IoT technologies.

We are teaching them to walk, climb stairs, open doors and communicate with humans.

Robot innovation for public-space applications is only in its infancy.

Within our cities, we can appreciate that small electric devices have a valuable role to play.

A 25 kg electric device making a 5 kg delivery is a vast improvement over a 1400 kg car making that same delivery.

A small electric device that can remove litter while we sleep could maintain cleaner pedestrian spaces.

A similar device spreading salt on walkways would make them safer for older pedestrians.

The many advantages of this technology are remarkable.

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But there is something more complex that we need to consider here.

Most robot applications are deployed within controlled work-spaces where nearby humans have been trained to collaborate with them.

Now these mechanized and motorized devices are entering spaces that have been previously reserved for pedestrians and their pets, baby carriages, and wheelchairs.

And they are entering bike lanes designed for through-traffic from cyclists — themselves vulnerable road users.

Many of these footways and bikeways are poorly designed — spaces that are frequently narrow or cluttered.

Footways, especially, have fire hydrants, trees, newspaper boxes, garbage bins, and retailer's signs and wares.

These spaces are organized for strolling, for window shopping, for waiting for the bus, for watching street performances — and for some of us to sit, beg or sleep.

Many restaurants have moved dining tables into these spaces.

These helper robots clearly bring enormous advantages, but they also bring new complexities to this space regarding shared rights-to-use.

What rights should retailers and restaurant operators have to use robots to deliver goods or groceries on these footways and bikeways?

What about residents who wish to receive deliveries or need improved walkway maintenance?

And pedestrians who have mobility, sight, or hearing losses?

What about footways that are already inadequate for existing traffic in their dimensions or conditions?

How should these devices interact with pedestrians at intersections, already the location of a majority of pedestrian fatalities?

In 2019, the ISO approved a project to draft a new standard for managing the realtime queueing and governance of loading and unloading of robotic vehicles for passengers and goods at the kerbside.

In 2020, this was expanded to include robots on the footway or sidewalk — the domain of the pedestrian.

This meant consideration of robot behaviour…

How should robots give way to pedestrians?

How should robots communicate their intentions to blind or deaf pedestrians?

And how should they use crosswalks?

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By 2021, the scope of the draft standard had further expanded to include how robots enter and leave bike lanes.

How should they behave while passing busy bus stops?

How could their numbers be limited within a single block face or during peak hours?

In 2022, we are adding elements for robot safety and location-readiness certification.

But even considering all this, there is still a deeply profound issue for these robots in our cities.

What are being introduced are small, motorized machines that are able to roll, walk and flow in and out of our footways, bikeways, and road shoulders — traversing any infrastructure they are permitted to use.

Within a decade, these devices will become far more spatially capable than active transportation devices — as well as cleaner, smaller, and quieter than our current motor vehicles.

Thereafter they will likely become more spatially nimble than most pedestrians.

We probably want all of these advantages, but as with everything we invent, there are unintended consequences.

Consider a time in five or ten years in which:

- a large variety of robots,
- that are multiply-purposed,
- that are each independently operated,
- by multiple independent operators,
- performing maintenance, delivery, and monitoring activities,
- each on independent and asynchronous schedules,
- all competing within a common public space with each other and with us humans.

We have an impending traffic management problem at least an order of magnitude more complex than our current urban traffic management problems.

Problems already exacerbated by the pandemic.

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The easy way out is to ban these devices.

At least **three** cities have already done that. Most recently, Toronto and Ottawa in Canada.

San Francisco banned delivery robots in 2017 but has since reversed its ruling.

BUT there are too many advantages to ban these devices, **AND** there are too many risks to leave them ungoverned.

Neither our cities nor the robotics and last-mile logistics industries can operate without standards.

Such standards must include matters for safety, data, governance, machine behavior, and traffic orchestration.

In my opinion, they should include standards for monetization, as well.

Ideally, international standards should inform national model codes.

Such national codes would inform jurisdictional legislation which in turn would inform local municipal bylaws.

So far, this is not how things are rolling out. In approximately 20 US states, an uncoordinated mix of simplistic legislation has been passed.

This has prodded a number of U.S. municipalities to instigate pilots and trials.

These will almost certainly result in bylaws local to those municipalities.

This will make also things more complex for each municipality and for each logistics, food delivery, and maintenance operator.

Over the next few years, robot operators will content with a growing variety of operating processes in many jurisdictions.

To address this gap in harmonization, the Urban Robotics Foundation consults with accessibility, logistics, municipal, planning, and robotics experts to draft international standards, guidelines, and certification methods to ensure that robotic passenger and goods systems are safe, managed, and contribute to improved livability for cities and their people.

As project leader for draft technical standard ISO 4448, *Ground-based automated mobility*, we are currently drafting 16 parts under the guidance of ISO technical committee 204, working group 19.

We consult with entities and experts in Europe, North America, and Asia.

Please contact us, if this work is important to you.

urbanroboticsfoundation.org

THANK YOU!