

# Executive Guide to PMRs

What you need to know about Public-area Mobile Robots

2024 Edition

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## Executive Summary

The leadership of any **government** (regional and/or municipal) and the executive management of any public facility such as **airports, hospitals, shopping malls, and parks**, will confront acquisition and deployment decisions regarding work- and support-systems that are becoming increasingly automated, and that claim ever growing numbers of applications.

Many of you already have.

Here, in this series of documents, we are focused on **mobile robotic systems**, in particular with devices, machines, or vehicles that move among pedestrians, citizens, visitors, passengers, patients, or patrons.

These devices may be providing a service (e.g. maintenance or security) within a facility or outdoor space, or they may be performing delivery tasks, using sidewalks, pathways and other pedestrian routes, and possibly crossing roads, bridges, etc.

We call these devices, **public-area mobile robots**, or **PMRs**. What is unique about PMRs is that those people among whom they are moving are generally uninvolved, unprotected, untrained, and frequently inattentive with regard to the task or activity being performed by the robot.

Nonetheless, matters of public or user acceptance, bystander safety, the perceived “behaviour” of these devices, whether people appreciate or fear them, and certain liability issues will become matters of concern to executives and their management teams.

This Executive Guide:

- summarizes the definition and current market circumstances for these devices;
- outlines the opportunities and challenges of engaging with PMR technology;
- briefly outlines the implications of delaying or advancing any decisions to begin testing PMRs;
- describes a way for you to access and process a body of deployment standards meant to help confirm and guide your deployment decisions; and
- briefly outlines the leadership you will be required to establish when the time comes, while outlining the standards and guidance available to that leadership team when they are ready for their next steps.

Please **reach out** to us if you have any questions.

<https://www.urbanroboticsfoundation.org/contact>

## Executive Director's Message



Welcome to the **2024 Executive Guide to Public-area mobile robots (PMRs)**, published by the Urban Robotics Foundation. This is Part One of a new series of publications that make up URF's Guides to Public-area mobile robots.

Bern Grush  
Executive Director

### Mobility Innovation and Open Standards

In 2019, I was appointed by the International Standards Organization (ISO) as the global lead for drafting what is now called *ISO DTS 4448: Intelligent Transport Systems - Public-area mobile robots*. With over 30 years of experience writing national and international standards on a range of topics including parking, road pricing and autonomous vehicles, I am passionate about transportation and mobility innovation. It is clear that creating global, open standards and helping leaders understand how to integrate those standards into their decision-making will expedite successful deployment of these vehicles and devices.

### Leadership is Risky

We are in a time of change—some would say disorder. Much is remarkable and exciting; and much is alarming and uncertain. A major force that drives this turmoil is polarization and one place we see its impact most emphatically is in engineered intelligence—remarkable for its potential but alarming because so few understand its workings or its outcomes. Two of these technologies are the juggernauts of ***automated vehicles*** and ***artificial intelligence as applied to mobility***.

Someone seeking to address a labour shortage or reduce motor vehicle traffic has reasons to want to deploy PMRs while someone confronted daily with physical accessibility issues has reasons to fear them *unless these same devices can enhance the accessibility experience of that person*.

It does not matter whether one seeks labour-saving convenience, safety, return on investment, a cleaner environment, cheaper delivery, or any of many other beneficial promises of this technology. What does matter is that, on net, cities and public facility operators need to see value, while no person is left worse off. And that is a tall order, indeed.

It is a very real possibility that unintended consequences from all this effort could turn out badly. We have never before put machines that move freely among unprotected, untrained humans without proximate human oversight and direct, mechanical control. Although there is always remote oversight this oversight is not apparent to pedestrians, cyclists, and motorists. A lack of understanding of this can lead to complaints or worse.

There is little in the tradecraft of complete streets that tells us the design rules that fit such a mobility case. This will be a very critical gap to close during the early years of the deployment of PMRs.



## About the Urban Robotics Foundation

Given the stakes outlined on the previous page, the Urban Robotics Foundation (URF) was created in 2021 as a non-profit organization to bring together stakeholders from around the world who are interested in the opportunities and challenges presented by public-area mobile robots (PMRs) and to help shape the related international standards.

URF'S goal is to build a global network of people focused on learning how PMRs can contribute to improved livability in urban ecosystems.

The purpose of the Urban Robotics Foundation is to create pathways to **readiness for PMRs with a focus on accessibility**. We do this in four pivotal ways:

1. Publishing a series of Guides to PMRs
2. Conducting workshops (virtual & in-person)
3. Providing vendor-independent advisory services
4. Leading the project to draft the ISO DTS 4448 deployment standard for PMRs

The early years for this technology will bring lessons; we will need to learn from those. Risks can be mitigated with careful testing through pilots and trials from which lessons can be shared.

The Urban Robotics Foundation is here to help. **We invite you to join us!**  
[www.urbanroboticsfoundation.org](http://www.urbanroboticsfoundation.org)

## Robots Among Us

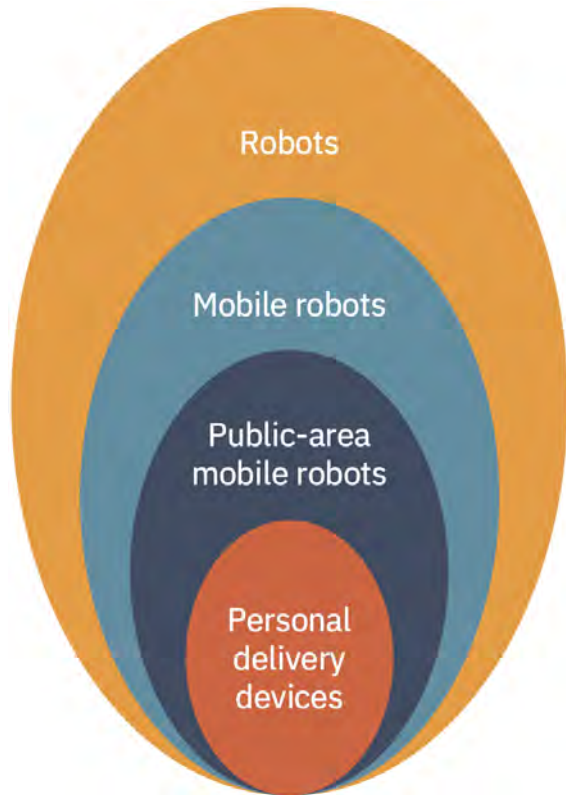
“Sidewalk delivery robots, once only a sci-fi reality, are getting more attention these days because of their potential to revolutionize ground-based delivery and serve as a “last-mile” solution that takes the human out of the loop. The robots simply navigate to your address while using cameras to avoid accidents and locking features to prevent theft.

"These robots claim that they can make it easier to do contact-free deliveries, empowering restaurants and consumers to save money, and even reduce greenhouse gas (GHG) emissions, traffic congestion, and parking problem on the streets. Could these robots even improve quality of life by safe and cost-effective delivery of food, medicine, and other small packages to individuals with no access to cars?"

From: Serena Alexander (2022) Robots Among Us: An Analysis of Community Perspectives and Reactions toward Sidewalk Delivery Robots in the City of San José. (Mineta Transportation Institute)  
<https://transweb.sjsu.edu/sites/default/files/2203-Alexander-Perspective-Sidewalk-Delivery-Robots.pdf>

## What are Public-area mobile robots?

**Robots** are designed in a near infinite array of sizes and purposes. Most are used in factory environments. Until recently, these devices were generally affixed and often caged in a specific work location. One early exception is a small consumer robot to vacuum floors in homes.



Over the past decade, **mobile robots** have become more capable. Mostly wheeled, they have graduated from factory and warehouse to more complex jobs in mines and on farms. They are often referred to as: industrial mobile robots (IMRs) or automated mobile robots (AMRs).

Mobile robots are now moving into more complex and dynamic spaces and use-cases, mixing among human bystanders. **Public-area mobile robots (PMRs)** perform a variety of tasks including maintenance, logistics, and security. In addition to using any number of wheels and with or without self-balancing ability, PMRs are also deployed using legs or tracks.

Currently, the **most popular type of PMR** is the **delivery robot** or '**PDD**' (**Personal Delivery Device**). They are most often used for "last-mile" food delivery, but new use-cases are constantly being tested and deployed in many locations.

*Figure 1: Defining Public-area mobile robots*

While the story of mobile robots is several decades old, the focus of the Urban Robotics Foundation is the more recent appearance of small mobile robots in public spaces shared with non-involved pedestrians ('bystanders').

The International Organization for Standardization (ISO) defines a Public-area mobile robot (PMR) as: "a wheeled or legged (ambulatory) ground-based device that is designed to travel along public, shared, pedestrianized pathways without the use of visible human assistance or physical guides" (*ISO draft technical standard 4448-1*).

PMRs can be teleoperated, but the key distinguishing feature is that there is no human operator on board or accompanying the device. PMRs can be used to carry humans as passengers (e.g., a wheelchair or assistive scooter robot) and they can be electronically tethered to follow or lead a human.



PMRs are deployed among ‘bystanders’ who may be inattentive, untrained, non-involved, and unprotected compared to trained personnel working and collaborating with robots in factories or warehouses.

## Use Cases

PMRs can be used to:

- deliver (last-mile, food, retail goods, medication, equipment)
- clean (mop, sweep, de-litter)
- maintain (mow, de-ice, remove snow)
- secure (patrol, protect, monitor, inspect)
- manage (parking citations, tour guide)
- transport people (travellers, patients, shoppers)
- and more...

Where permitted, PMRs can operate in public spaces such as city sidewalks, college campuses, pathways, hospitals, parks, zoos, airports, and malls. They can be used both indoors and/or outdoors. Crossing streets and bike paths present some of the most complex interactions.



Figure 2: Example form factors of PMRs; Ottobot delivery robot (Ottonomy.io), Saltnex (Capra Robotics), Wheelchair robot (Cyberworks Robotics)

## Market Developments

Overall, the global mobile robot market is expected to grow in value from USD 20.3 billion in 2023 to USD 40.6 billion by 2028 at a compound annual growth rate (CAGR) of 14.9% (Source: MarketsandMarkets, July 2023).

If we focus *only on the last-mile delivery segment* of the market, the CAGR for PDDs is estimated to exceed 25% from 2023 to 2032, driven by advancements in robotics technology and the entry of new players. (Source: Global Market Insights April 2023)

### Does our history with e-scooters portend a direction for PMRs?

All of us are aware of the numerous positive and negative outcomes of recent mobility innovations such as ride hailing, e-scooters, and e-bikes. Many of the promised outcomes were framed in comparison to then-current contexts — “ride-hailing is better than using taxis”, “e-scooters reduce automotive congestion,” and “e-bikes reduce automotive ownership.”

Often, negative outcomes get serious notice only after deployment is underway. That is generally because these outcomes only become socially observed and politically charged when innovations begin to scale: “ride hailing takes riders from the transit system,” “e-scooters are lying on the pavement everywhere,” and “e-bikes are being driven on the sidewalk!” Negative outcomes tend to displace the positive outcomes, at least in the press.

On the next page, Figure 3 shows the current state of regulation and, by implication, municipal readiness, for e-kickscooters in a large sample of worldwide cities. According to "Scooter Race," a 2023 report published by McKinsey, e-scooters are banned in cities accounting for 30% of the sample population, unregulated in 32% of the sample, and regulated in 39% (either by tender (10%) or open with no player-limit (29%)).

It is clear that PMRs are very different from e-scooters. E-scooters move people and are controlled by human riders who may or may not follow rules or be thoughtful about alarming or inconveniencing bystanders. PMRs move goods, execute maintenance and security tasks, and are controlled by a fleet operator using software and/or with employees who are teleoperators.

Those differences aside, a major similarity is that both device types share space with active transportation users, whether pedestrians or cyclists and both cross roadways thereby interacting with motorized traffic. It is here that the similarities are important even though solutions are very different.

**Banning PMRs** will result in lost opportunities and services, especially for aging and mobility challenged populations. As well, any municipality that maintains a complete ban would miss future opportunities to reduce logistics traffic in urban neighborhoods.



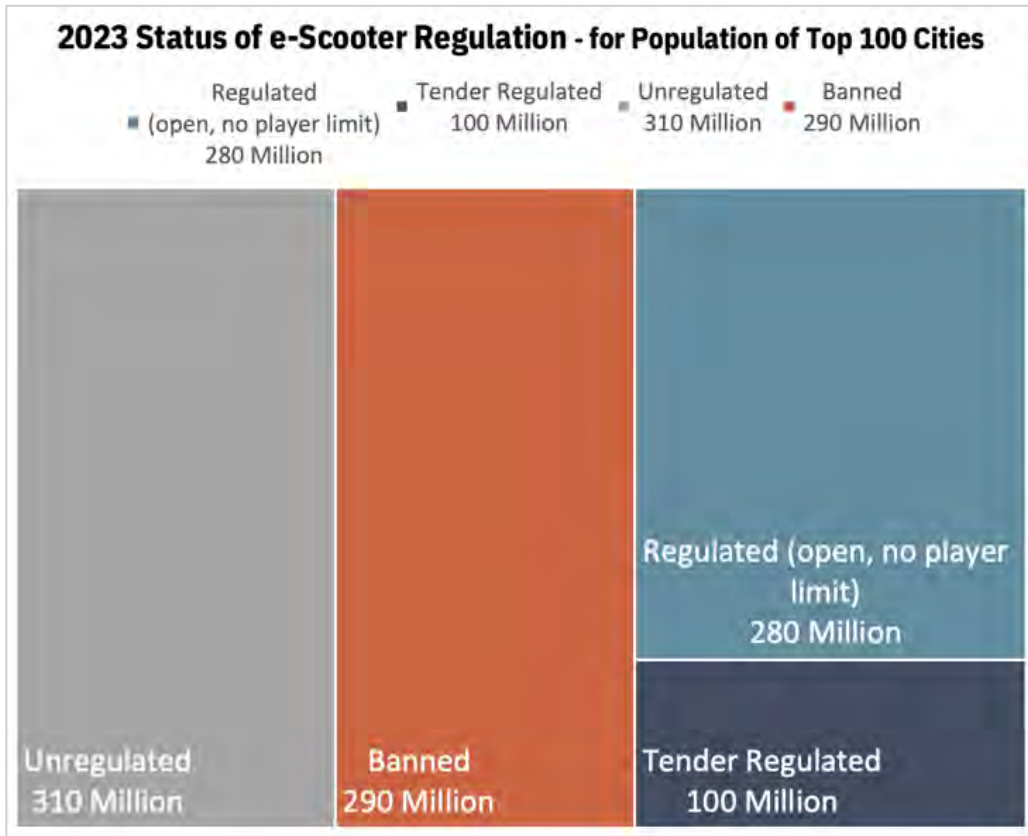


Figure 3: 2023 Status of e-Scooter Regulation Globally. Data source: <https://www.mckinsey.com/featured-insights/sustainable-inclusive-growth/chart-of-the-day/scooter-race>

**Unregulated PMRs** may result in many negative outcomes, such as unexpected or competitive behaviours at road crossings, inability to control congestion, or insufficient ability for a municipality to convey traffic rules or real-time road information.

We provide a more in-depth assessment of the risks and benefits of regulating or banning PMRs in URF's **2024 Discovery Guide to PMRs**.

## What is the Cost of Taking a 'Wait and See' Approach?

According to a 2020 report **The Future of the Last-Mile Ecosystem**, published by the World Economic Forum, "There has never been a time of greater change for the 'last mile'. Consumers order more things online, expecting more control and faster deliveries. ... Inner cities are struggling with traffic congestion and air pollution due to the increasing number of delivery vehicles, their emissions and second-lane parking... These developments are not surprising, but they are challenging because they are not linear. Rather, they are interwoven in complex ways that reinforce their speed and magnitude. This poses new questions to last-mile ecosystem players: ... Which disruptive technologies and delivery chain

innovations should be prioritized over others? Which regulatory city interventions offer maximum impact?"

Figure 4 shows a forecast increase of 36% in the number of delivery vehicles from 2019 to 2030, an increase of 6 Mt of CO<sub>2</sub> and a 21% increase in the average commute time for a representative city among the Top 100 cities globally in a base case scenario.

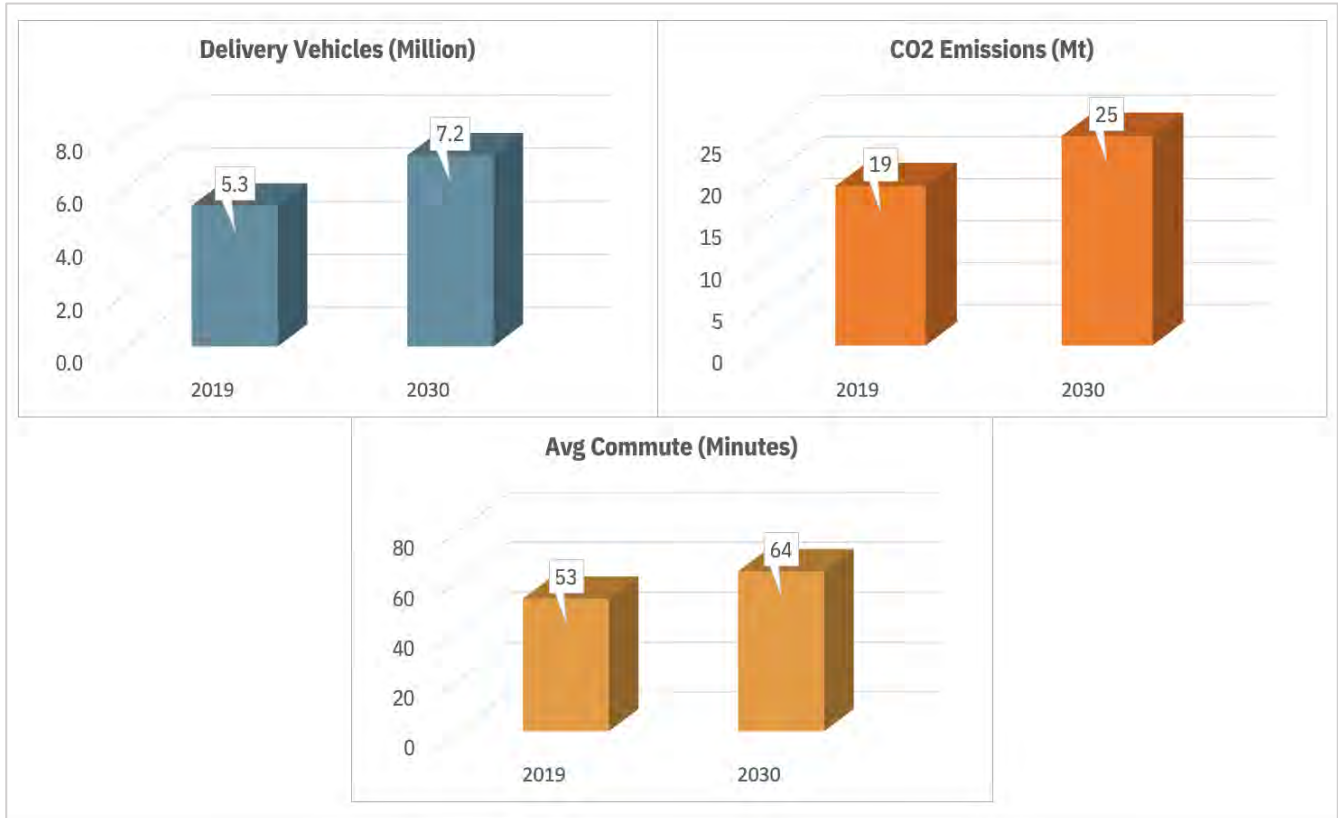


Figure 4: Forecast impact of taking a 'wait and see' approach (*The Future of the Last Mile Ecosystem*)  
 Source: [https://www3.weforum.org/docs/WEF\\_Future\\_of\\_the\\_last\\_mile\\_ecosystem.pdf](https://www3.weforum.org/docs/WEF_Future_of_the_last_mile_ecosystem.pdf)

The WEF recommendations are aligned with the approach we take at the Urban Robotics Foundation:

"In terms of next steps, we encourage private and public players to **team up and accelerate the roll-out of pilots** on the suggested interventions. Also, we believe there is tremendous value in **building discussion networks or consortiums** for cities to exchange the most effective methodologies, discuss challenges and liaise with private sector players. Besides, we believe that **robust, harmonized regulations** – e.g., for autonomous driving and inner-city e-mobility – would help automotive OEMs and logistics players to better allocate R&D investment and accelerate the adoption of sustainable supply-chain technologies. Lastly, the **use of data and advanced analytics is a vital enabler** for interventions such as effective load-pooling and real-time traffic control. Also, **joint data standards and effective data sharing** can bring tremendous benefits to all ecosystem players.

## Opportunities

Public-area mobile robots – robots operating near human bystanders in public spaces – present substantial opportunities while also posing significant challenges in terms of complex interactions with active humans sharing those spaces.

Depending on how they are deployed, PMRs offer opportunities distributed among key stakeholders including: municipal governments and urban planners, logistics operators, facility operators, accessibility advocates, environmental policy makers, and the general public as shown in Table 1.

*Table 1: Example opportunities of PMR deployment by stakeholder group*

Stakeholders	Opportunities
<b>Municipal Governments &amp; Urban Planners</b>	Improve services to underserved areas, data-driven insights, public safety, sanitation, space efficiency, and infrastructure management
<b>Logistics Operators</b>	Greater modal flexibility, reduced costs, remote access, service scalability, and alleviation of labour shortages
<b>Facility Operators</b>	Address traveler and patient mobility, facility sanitation, area security, and alleviation of labour shortages
<b>Accessibility Advocates</b>	Universal accessibility, collaboration with active transport stakeholders, and commercial pressure for ADA compliance
<b>Environmental Advocates</b>	Energy efficiency, CO <sub>2</sub> reduction, reduced congestion at loading/parking spaces implies reduced emissions, noise, and idling
<b>Public</b>	Improved livability, enhanced services, reduced traffic, safer neighbourhoods, and more active transportation options

The **necessity** for deploying PMRs is being underscored by labour shortages which, in turn, are driven by aging populations in many countries. Even re-shoring has labour impacts that ripple through the logistics chain. The protest of “*robots will take our jobs,*” is being out-shouted by concerns of “*we need robots to support the decline in available labour*”.

The combination of de-globalization and falling fertility demands more agile mechanization to support consumption. In other words, in many populations the cry of “*we need jobs to maintain our standard of living*” is being replaced by “*we need robots in order to maintain our standard of living.*”

## Accessibility

If system planning, bylaws, service provisions, and infrastructure planning each make **accessibility a first priority**, the realization of these opportunities can be enormous and shared by all stakeholders.

**Putting accessibility first** means our deployments will engender the greatest degree of acceptance, community value, and safety. If accessibility in its broadest sense is not a critical, primary design filter, it is unlikely that PMRs will achieve more than a small fraction of their potential.

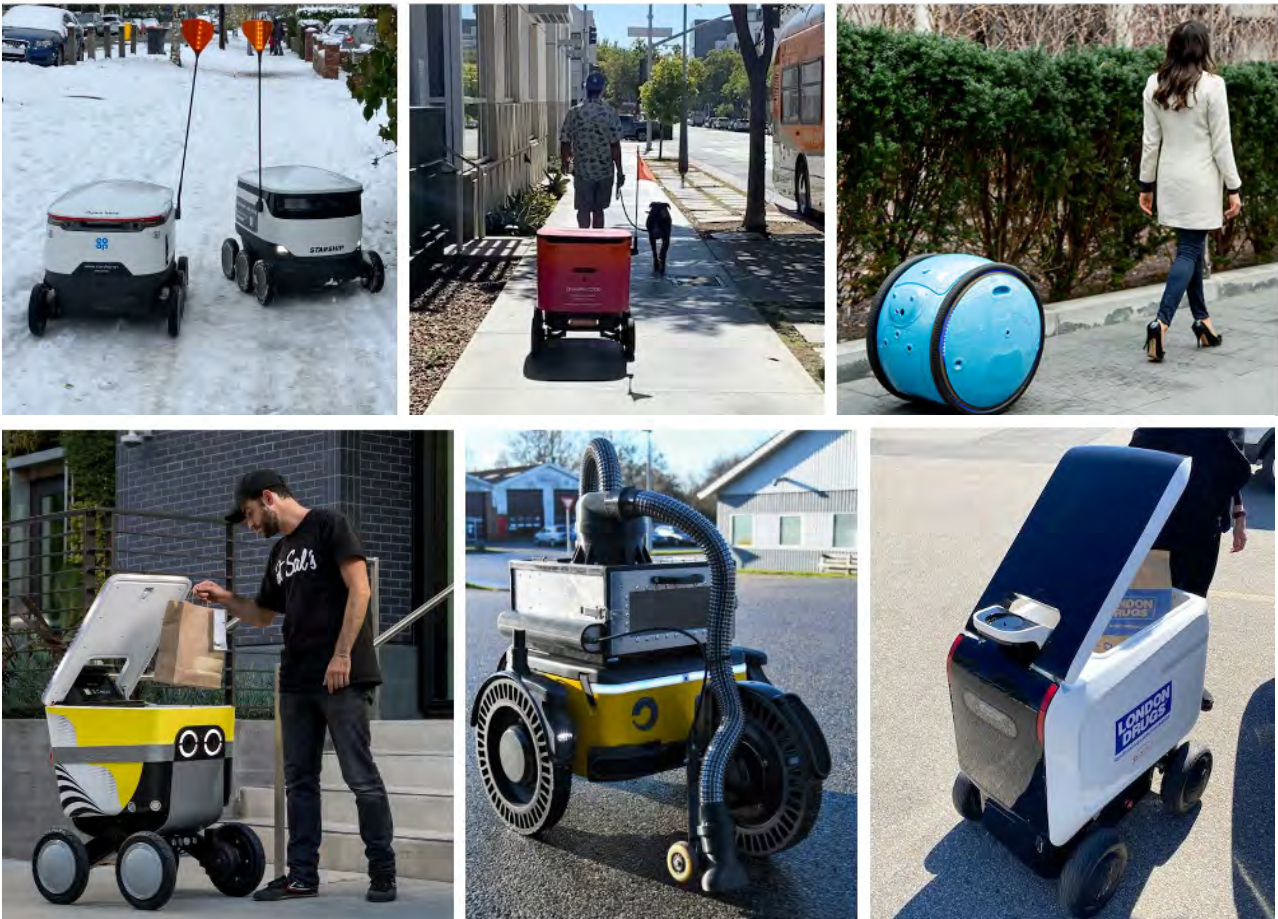
Our history of sharing urban space with the automobile, a flawed design history, illustrates the outcome of putting the machine and its purposes first.

### Drivers of Change

The **existence** of PMRs is made possible by recent advances in sensors, software, tiny motors, and mechatronics that were initially developed for factories, farms, mines, and warehouses.

The **popularity** of PMRs has been accelerated by robots used for delivery, surveillance, and sanitation in response to COVID.

The **adoption** of PMRs is made easier by early legislation in several countries such as Estonia, Japan, Finland, and South Korea, as well as in more than 20 US states.



*Figure 5: Examples of PMRs: Starship robots on snowy path, Coco Delivery, Piaggio (Gita) follow-me robot, Serve Robotics food delivery, Capra Robotics (Butty), Real Life Robotics (Bubs).*



## Challenges

PMR challenges are likely to weigh heaviest on municipal governments. Consider that municipalities carry responsibility for accessibility and active transportation issues as well as for vibrant commercial zones, and safe, well-maintained environments.

Table 2 shows examples of challenges that are relevant for the same stakeholder groups identified in Table 1. It is well-known that every opportunity can also present challenges. The good news is that challenges are not show-stoppers. In all cases, challenges are matters that can be overcome by investment, bylaws, effort, agreements, collaboration, planning, research, and dialogue.

*Table 2: Example challenges for PMR deployment by stakeholder group*

Stakeholders	Challenges
<b>Municipal Governments &amp; Urban Planners</b>	Infrastructure readiness, safety concerns, regulatory frameworks, liability management, equitable service availability, keeping regulations up-to-date, cyber security, data privacy, and traffic orchestration
<b>Logistics Operators</b>	Public acceptance, map maintenance, changing regulations, operational scalability, interoperability and standardization, traffic orchestration, and technical limitations
<b>Facility Operators</b>	Safety, insurance, customer comfort, and increased complexity at command centres [orchestration]
<b>Accessibility Advocates</b>	Pedestrian crowding, protection and promotion of accessibility rights, and balancing needs of all active transport users
<b>Environmental Advocates</b>	Recycling of PMRs and their batteries and sidewalk congestion
<b>Public</b>	Communications, public acceptance, and understanding how to engage with PMR technology

Challenges weigh heavily on municipal governments even if higher levels of governments set guidelines thereby alleviating at least some decision-making pressure. For example, safety concerns, could be absorbed into certification programs based on various related safety standards set by higher levels of government.



## Creating Open Standards

The International Organization for Standardization (**ISO**) is an independent, non-governmental organization with a membership of 169 national standards bodies. Through its members, the ISO brings together experts to share knowledge and develop voluntary, consensus-based, market relevant, international standards that support innovation and provide solutions to global challenges.

URF's Executive Director, Bern Grush, is the global project lead for drafting the ISO standard for the parameters and procedures for PMR behaviour and deployment – *ISO/TC204/WG19 DTS4448 – Public-area mobile robots*.

There are sixteen parts to draft ISO-4448, organized into four major themes as listed in Table 3.

Table 3: Structure of Draft Technical Standard ISO-4448

Theme	Parts
<b>Definitions and profiles</b>	<ol style="list-style-type: none"> <li>1. Overview of paradigm</li> <li>2. Data definitions and general concepts</li> <li>3. Security, privacy, testing &amp; data: Threat, vulnerability and risk profiles</li> </ol>
<b>Machine behaviours</b>	<ol style="list-style-type: none"> <li>4. Loading &amp; unloading of goods and passengers</li> <li>5. Access on human pathways</li> <li>6. Journey planning sufficiency</li> <li>7. Behaviour on human pathways</li> <li>8. Robot-to-human communication signals</li> <li>9. Journey data recorder</li> </ol>
<b>Operational context</b>	<ol style="list-style-type: none"> <li>10. Suitability of pathway infrastructure</li> <li>11. Environmental worthiness</li> <li>12. Post-crash procedures</li> <li>13. Mapping maintenance</li> </ol>
<b>Personal &amp; safety</b>	<ol style="list-style-type: none"> <li>14. Personal assistant robots for tasks and goods</li> <li>15. Personal assistant robots for human transport</li> <li>16. Safety and reliability</li> </ol>

At URF, we believe the biggest barriers to successful PMR deployment are related to municipal readiness and public acceptance (or lack thereof). Once a new standard is published by the ISO, it can take years for stakeholders to fully understand how to implement the standards and even longer for the benefits to be fully realized across the industry and among the public.

By publishing the first edition of these guidebooks in advance of the release of ISO-4448 (anticipated in stages during 2024-2026), URF wants to help maximize the promised benefits of these technologies

and help expedite public dialogue and acceptance. Through sharing best practices, case studies and research findings, and through conducting workshops and providing advisory services to support deployment teams, we can help improve the chances of successful deployment while minimizing any unintended consequences during pilot testing and early deployment phases.

## Governance and Readiness



Figure 6: Deployment Pillars are key elements at each "maturity stage" of the PMR deployment process.

If PMRs are to operate at scale in public, pedestrian spaces, then there are several governance concerns that should be consistently understood and addressed. Transparency demands that pedestrians and cyclists, users of sidewalks, people of all ages and abilities are able to understand and support the rules that guide these machines. Ultimately, it is essential that these robots behave in similar ways across operators and from one city or town to the next.

Makers of these devices and operators of their fleets must understand what is expected of robotic equipment if they are to succeed in these spaces. And local governments will need a template from which to govern their streets, intersections, police, and insurers in regard to safety, traffic, and tort.

### Deployment Pillars

PMR deployment impacts a number of areas of municipal responsibility. In this guidebook series, we have grouped these areas into six " **Deployment Pillars.**"

**Readiness:** Careful planning is needed for trials, limited deployments, and eventual larger-scale, multi-fleet, mixed logistics and maintenance operations. This is a critical endeavor that should include:

- Consulting with community stakeholders to understand the priority use-cases
- Selecting suitable communities for trials
- Determining changes needed to bylaws; setting up frameworks for licensing and permits
- Understanding required infrastructure investments
- Analyzing data, reporting, and planning for subsequent deployments

**Behavior:** Establishing a common baseline of behavior for PMRs is crucial. This includes how they interact with pedestrians, signal their intentions, and ensure safety for all – including those with disabilities. ISO-4448 offers a framework for these behaviors, which can be adapted to your community's needs.

**Orchestration:** There are systems for air traffic control and traffic signals and rules of the road for motor vehicles. However, human pathways such as sidewalks lack formal orchestration systems. Currently, pedestrians move freely, engaging in various and arbitrary activities. ISO-4448 offers a framework to integrate robots into these spaces minimizing negative impacts for pedestrians and for traffic at road crossings.

**Certification:** As PMRs become increasingly autonomous, governments need assurance they are safe, identifiable, cyber-secure, and controllable. Certification, whether self-, agency, or third-party certification will be essential for operation in pedestrian spaces.

**Enforcement:** Fleet operators will be highly motivated to ensure their PMRs are safe and programmed to follow all agreed rules. Still things can go wrong – a robot might fail mid-road-crossing. There may be rare circumstances in which a robot is controlled for malicious purposes. In all cases, it must be legally and safely possible for the jurisdictional government or agency of that government to halt, commandeer, seize, or impound a robot. An obvious example of this might be that city personnel battling a fire is permitted to block or physically remove a robot.

**Monetization:** To ensure orderly operation, managing PMR traffic will be akin to overseeing ships, planes, and cars. Monetization, likely overseen by a city or regional government, will be needed to fairly allocate and recover the costs for orchestration, certification, and enforcement.

Deployment Pillars will evolve as PMRs diversify and diffuse. These devices will become increasingly ambulatory and capable in other ways as they continue to be integrated into the operational fabric of our cities and public facilities.

## The Leadership You Will Need

The advent of pedestrian-scaled robots coupled with automated passenger transport in our cities promises a transformative wave of change in the coming decades. This shift will surpass the combined impact of the automobile's introduction at the end of the 19th century and all mobility innovations since 2005. Beyond automation and technology, we must also consider how these systems influence accessibility, crime, efficiency, jobs, safety, and various other aspects of urban life.

Safety, for instance, extends to crosswalks, cybersecurity, winter maintenance, crime reduction through patrolling robots, and the well-being of pedestrians with disabilities. Robotics will permeate nearly every facet of urban planning and life itself. Consequently, cities and public facilities require

leadership that encompasses accessibility, equity, political, and social dimensions for urban success — far beyond “just technology.”

In a smaller municipality or public facility, a majority of these concerns might be the purview of a single department (e.g., Public Works), whereas in larger cities, they might impact many different departments. Each city will organize its approach to suit, and cities will likely need to change their approach several times over the next decades.

### Standards-mediated Leadership

The ISO 4448 draft standard for PMRs is intended and designed for **Governance and Deployment** leadership. It will be critical to your jurisdiction or facility, and to any superior level of government that has relevant authority in your jurisdiction or facility, to have access to standards and deployment models for PMRs. While there are multiple layers of consideration, your leadership will primarily focus on the governance and deployment layer at the top of Table 4 while remaining aware of the issues implied in the lower four levels.

Table 4: A view of system layers for Public-area mobile robots

Layer	Areas of Concern (examples):			
5 <b>Governance &amp; Deployment</b> (ISO DTS 4448)	Acceptance Accessibility Communications Crash Reporting Enforcement	Insurance Liability Location safety Orchestration Personal Assistant	Personal Transport Pickup/drop-off Regulation/Bylaws Rules of the road	Seizure Traffic Management Vandalism Waiting space
4 <b>Robot Tasks/ Use-cases</b>	Cleaning Delivery	Measuring Monitoring	Salting Security	etc.
3 <b>Robot Operations</b>	Charging Insurance	IoT Orchestration	Pound (for Seizure) Signals	etc.
2 <b>Operational Design Domain</b>	Infrastructure	Mapping		etc.
1 <b>Machines</b>	Ground-based	Ambulatory	Tracks	Wheels



## Your Next Steps

As you begin (or continue) your journey to deploying mobility innovations such as PMRs, we are pleased to offer additional publications, webinars, workshops and vendor-independent advisory services to support you. This Executive Guide to PMRs is Part 1 of our guidebook series. URF's Discovery and Project Guides (Parts 2 & 3 respectively) will be available for purchase on our website as they are published. <https://www.urbanroboticsfoundation.org/guidebooks>

### **URF Discovery Guide to PMRs: Opportunities and Challenges with Public-area mobile robots**

The **URF Discovery Guide to PMRs** provides further exploration of the use cases for PMRs with examples from around the world. It offers details and examples of the range of opportunities, challenges, benefits and risk mitigation strategies to consider when deploying mobility innovations such as PMRs. The Discovery Guide can be considered a prerequisite to fielding questions from city council to municipal staff—or questions to city council from accessibility advocates. A prospective PMR project manager would read this before advising a municipal development team, voting for project budgets, or deciding priorities for a pilot. Technology companies would read this to gain insights on how their products and services could better align with needs and opportunities within urban ecosystems.

**Target Audience:** Municipal/Regional governments, transportation planners, engineering consultants, robot designers, fleet operators, system integrators.

**Purpose:** Inspire readers with examples and a summary of the issues faced by stakeholders across the spectrum of PMR use cases while sparing them the project details necessary for execution.

### **URF Project Guide to PMRs: Best practices while preparing for Public-area mobile robots**

The **URF Project Guide to PMR Deployment** is intended for project teams who are ready to dig into the details of how to move forward once a pilot project is being considered or has been identified. It can be purchased in its entirety or in separate modules which will be used as workshop handouts for team training (virtual or in-person). The Project Guide is organized into thirty chapters based on a detailed review of the six **Deployment Pillars** (Figure 6) evolving through five defined maturity stages analogous to a Capability Maturity Model for technology deployment. Our Project Guide takes the reader through progressive steps from discovery to expansion and optimization at scale, for each pillar. Each chapter offers suggested checklists and recommendations for each stage and pillar.

**Target Audience:** Smart City project teams, attendees of URF workshops and training sessions, fleet operators, system integrators.

**Purpose:** Provide a detailed guide through all steps and deployment issues with informative (rather than normative) connections to ISO DTS 4448 throughout.



## Acknowledgements

Thank you to our supporters, members and sponsors who make our work possible.



If you are not already a member, we invite you to join the Urban Robotics Foundation to become more engaged with our community. Member benefits include strategic networking for setting up pilot projects and sharing of key learnings/best practices, early access to review and help shape the ISO draft standard, and the opportunity for discounts on products and services provided by URF and our affiliate partners/organizations.

Thank you for your interest in preparing for the deployment of public-area mobile robots and for reading our Executive Guide to PMRs. Please visit [www.urbanroboticsfoundation.org](http://www.urbanroboticsfoundation.org) for more information on URF membership, and/or to inquire about our other publications, webinars, workshops, and advisory services.

Lee St. James (she/her), Managing Director, URF and Bern Grush, Executive Director, URF

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