2021
Personal Delivery Device
Mid-Pilot Evaluation

November 2021

Table of Contents

Executive Summary

About the Pilot

In July 2021, the Pittsburgh Department of Mobility & Infrastructure (DOMI) launched a six-month personal delivery device (PDD) pilot ("Pilot") with 1 vendor and 10 PDDs in a 1.5 square mile radius in the Bloomfield, Lawrenceville, and Garfield neighborhoods. The Pilot aimed to better understand what role PDDs play as a potential delivery option in Pittsburgh; the operational challenges PDDs present and the ways they can be mitigated; and how effectively PDD vendors can operate while promoting increased delivery options and access for everyone.

Mid-Pilot Evaluation

This report reflects the learnings to date from the Pilot. Given that there are still several weeks remaining in the pilot, there are multiple areas where learnings are still to be determined given that data is still being collected.

Pilot Overview

Pennsylvania Senate Bill 1199/Act 106

On October 20, 2020, the Pennsylvania Legislature passed Senate Bill 1199, authorizing and defining personal delivery devices. On November 1, 2020, the bill became law without the Governor's signature. SB 1199 includes PDDs under the definition of "pedestrian" and defines a PDD as a ground delivery device manufactured for transporting cargo or goods, operated by a driving system that allows remote or autonomous operation, or both, and weighs less than 550 pounds without cargo.

The bill provides PennDOT with general and sole authority over PDDs and preempts local authority over PDDs except in instances where the local authority determines, after consultation with the PDD operator, that operation of the PDD constitutes a hazard. This law limits the City's ability to oversee or regulate PDDs on city streets and sidewalks. However, DOMI worked with community members and stakeholders to submit comments to PennDOT while the department developed policies governing the authorization of PDDs.

On January 30, 2021, SB 1199 went into effect and PennDOT published its "[Personal Delivery Device (PDD) Operations Policy](#)" and began accepting applications from companies seeking to operate PDDs in Pennsylvania.

Pilot Planning

After SB 1199 went into effect and PennDOT published its PDD Operations Policy, DOMI knew it was critical for leadership and staff to learn more about this emerging technology and the implications this shift in delivery services could have on our public space. The City already had grant funding from the Knight Foundation to focus on community-driven automated or "self-driving" technology pilots, along with other grant cities (San Jose, Detroit, and Miami-Dade County).

DOMI staff recommended using the Knight Foundation funding to launch a PDD pilot aimed at better understanding what role PDDs play as a potential delivery option in Pittsburgh; the operational challenges PDDs present and the ways they can be mitigated; and how effectively PDD vendors can operate while promoting increased delivery options and access for everyone. DOMI staff began outreach to Registered Community Organizations (RCOs) and Business Improvement Districts (BIDs) to identify a willing community partner to assist with shaping the pilot and facilitating community engagement.

Following conversations with a number of RCOs and BIDs, the Bloomfield neighborhood was identified as an ideal location for this pilot, in part due to its diverse demographics, wide sidewalks on commercial streets, engaged community group, and high number of small, locally

owned businesses. After conversations with additional communities and local businesses, the pilot area was later expanded into portions of Garfield and Lawrenceville.

With support from the Knight Foundation and collaboration with the other grant cities (San Jose, Detroit, and Miami-Dade County), Kiwibot was selected as the PDD provider for this pilot. Kiwibot was selected in part because of its small, slow, remotely operated PDDs, its willingness to have a collaborative relationship with municipalities, share data, and participate in public engagement alongside City staff.

After identifying an ideal location and willing provider, DOMI proposed the pilot concept to the community at virtual meetings hosted by Bloomfield Development Corporation (BDC) in April and June 2021. During these meetings, the community provided input on the proposed pilot, which led to the implementation of an emergency response plan, the EngagePGH page, and an FAQ. More information on the community meetings can be found on the EngagePGH project page as well as on Bloomfield Development Corporation's website.

Pilot Launch

In July 2021, the Pittsburgh Department of Mobility & Infrastructure (DOMI) launched a six-month personal delivery device (PDD) pilot ("Pilot") with 1 vendor and 10 PDDs in a 1.5 square mile radius in the Bloomfield, Lawrenceville, and Garfield neighborhoods.

The Pilot took a phased approach, as required by PennDOT, with only 1 or 2 robots initially operating to do mapping with a human supervisor within 30 feet of the device and available to answer questions from residents and visitors who passed by or interacted with the robot. Kiwibot then gradually began operating more robots in the public space. In September 2021, Kiwibot was granted authorization from PennDOT to begin operating remotely ("Phase 2"), without the requirement of a human supervisor staying within 30 feet of the robot. After Kiwibot was authorized to enter Phase 2 of operations, it began offering deliveries for local businesses at no cost to the business or customer.
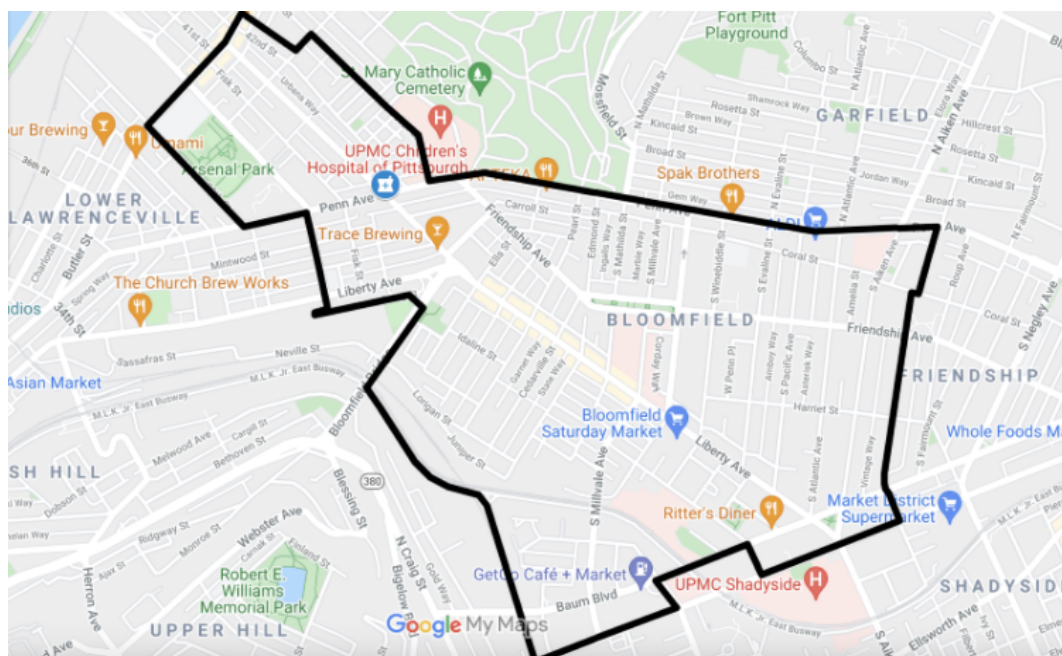
Local Partners

During the Pilot, DOMI and Kiwibot partnered with local businesses and non-profit organizations to offer deliveries using the robots. The following are those local businesses and non-profits and the use cases being explored:

- **Carnegie Library of Pittsburgh**

    - Delivering books and educational materials to youth

- **Wilson's Pharmacy**

    - Delivering over-the-counter goods and medications to customers, with a focus on seniors and customers with travel limitations

- **Taquitos**

    - Individual meal deliveries to customers

The business and non-profit organization partners were selected, in part, because they provided an essential service to the community and were either locally owned and operated or not-for-profit. Kiwibot also worked with the Center for Victims to introduce the delivery robots to service animals who may encounter the Kiwibot robots or future providers in the public space.

PDD Operations and Deliveries

Operations

Month	Miles (operations)	Miles (mapping)	Miles (demo)	Total Miles	Avg. Miles per week
July	29.59	46.24	13.25	89.08	22.27
August	55.49	38.80	0.48	94.77	23.69
Sept	212.96	21.05	7.39	241.40	60.35
October (1-15)	42.90	0.00	0.00	42.90	42.90

***Note a significant increase during September, due in part to the fact that Kiwibot was permitted to begin operating in Phase 2, allowing several more robots to operate at a given time.

Orders

Month	Simulated Orders	Real Orders
July	31	0
August	59	0
Sept	215	3
October (1-15)	41	0

Simulated orders are orders artificially created by Kiwibot in order to test certain operating routes and to collect data for the City during the Pilot. A delivery robot travels from a origin point to a destination point in the operating area, but there is no real customer or cargo involved.

Safety and Compliance

Internal Incidents (reported by Kiwibot) **-** issues that occur during operations related to the software, cameras, sensors, connectivity, etc.

Examples include signal latency, software and hardware issues, command issues, and navigation issues (e.g., robot gets stuck).

Month	Internal Incidents
July	30
August	17
Sept	74
October (1-15)	17

*Note a significant increase during September, due in part to the fact that Kiwibot was permitted to begin operating in Phase 2, allowing several more robots to operate at a given time.

External Incidents (reported by Kiwibot) **-** issues or events that occur involving third parties

Examples include crashes with vehicles or pedestrians, vandalism, and 3rd party damage to the robot.

Month	External Incidents
July	0
August	0
Sept	7
October (1-15)	3

*Details of External Incidents can be found in Appendix A.

<u>3-1-1 Service Requests</u> - Only one 3-1-1 request has been received during the pilot period. The submitter stated a concern for friends that are blind or have low vision and that they felt uncomfortable with the robot on the sidewalk and felt as if the robot would have run into them if they did not move aside when approaching the robot on a sidewalk.

Community Outreach

Pre pilot launch:

- Feb - April 2021 - Biweekly meetings between DOMI and BDC
- April & June 2021 - Two open community meetings hosted by BDC
- June 2021 - Launched EngagePGH website

Post pilot launch:
- Ongoing - On-street engagements during operations
- Ongoing - Visited areas outside of the operating area with the robots
- 07/31/2021 - Attended Bloomfield Saturday Market
- 08/17/2021 - Convened Steering Committee
- 08/28/2021 - Attended a youth event hosted by the Carnegie Library
- 09/14/2021 - Demo with Steering Committee
- 09/21/2021 - Attended Lawrenceville Farmers' Market
- Upcoming - November - Coordination with Carnegie Mellon to do observation surveys of robot/pedestrian interactions
- Upcoming - November - Demo and education session with Assemble in Garfield

Learnings

General

- Residents and community member organizations value the opportunity to be part of the conversation around emerging mobility technologies. There is value in early community conversations and pilots around new technologies. Communities working together will be better prepared for emerging technologies, including personal delivery devices.

Learnings by Key Research Questions

- **Can PDDs be deployed on sidewalks without creating safety or accessibility issues for other users?**

  DOMI, PennDOT, and Kiwibot have not determined exactly what makes for a safe operating environment but have identified a number of metrics (number of complaints filed, number of reported device related injuries or fatalities, perception of safety). This data is still being collected; however, as shown in the previous section of this report, there have been few complaints and no reported injuries at the midpoint of the Pilot.

  The limited number of PDDs (never more than 10) operating at any one time makes it difficult to determine how many can operate at the same time proximate to each other and still operate safely. More data is needed.

  According to a recent report about PDDs by the Pedestrian and Bicycle Information Center, "...wheelchair users require a corridor at least three feet wide for passage. They also need four feet of lateral space plus additional room to maneuver; therefore, with PDDs allowed to share and potentially block sidewalk space, communities will need to consider ways to expand and ensure passable spaces (six to eight feet wide) and access points such as doorways and curb cuts." This report also noted that, unlike robots used in warehouses and industrial settings, there are no safety features like bumpers, power buttons, or bars to grab to right PDDs that have tipped over or to manually stop them.

- **What's the necessary infrastructure/conditions for PDDs to operate? (e.g. curb cuts, sidewalk widths, street connectivity, etc.)**

  At a minimum, we've observed the following requirements for operation so far:
    - Curb cuts (unobstructed)
    - Street crossing that does not require pushing a crosswalk button
    - Clear path with a minimum width (undetermined at this point)
    - Relatively smooth pavement
    - Robot connectivity to remote operator

- Well-functioning storm water system
- Clear weather (little to no rain or snow)

It is worth noting that most of the necessary infrastructure required for PDDs to operate are also necessary for human pedestrians to safely and comfortably navigate the public space.

Kiwibot did map the Garfield neighborhood in Phase 1 of operations; however, Kiwibot noted that there are many places in Garfield that the robot cannot operate due to infrastructure limitations such as cracked sidewalks, lack of sidewalks, etc. Kiwibot also can't operate if there are things blocking the sidewalk such as overgrown trees or bushes or if cars are parked blocking the sidewalk, etc.

- **Can the Pilot (and future pilots) cover their costs or will they need subsidies to operate in the future?**

  PDDs are most likely to be successful in high density areas with high income earners. Subsidies (paid for by government or non-profits) may be necessary in lower density locations or to lower income populations.

  Specific to this pilot, Kiwibot cannot cover its costs as the Pilot is currently conceived. For a variety of reasons, there is minimal demand for the service in the Pilot use cases. This is not to say there may not be demand elsewhere; for instance, Kiwibot believes that demand exists in the business-to-business (B2B) market.

  The Pilot use cases do not seem poised to continue once the Pilot is over and there is no longer funding to cover the full operational costs of the service, as there has not been enough demand. Kiwibot has expressed interest in a B2B partnership to continue operations in Pittsburgh.

- **Who adopts PDDs and why?**

  Kiwibot and other PDD operators are still exploring use cases. These markets may be evolving, especially as communities continue to respond to the Covid-19 pandemic and new variants. However, at the mid-pilot point, deliveries and survey responses have been minimal.

- **Can PDDs meet a defined community need?**

  At the start of the pilot, Kiwibot found that less than 30% of local businesses in Pittsburgh have their own ordering platform and therefore depend on third parties for deliveries. Those third parties rarely, if ever, share customer data and often charge extensive fees to drive volume.

It is too early to determine if the use cases currently deployed during the pilot period will successfully meet the delivery needs of small businesses or add a true value to residents. Due to low demand for deliveries, only small numbers of meals, goods, medication, and books are being delivered by the PDDs.

If we frame this question as "have PDD deliveries met a defined need?", the answer as of the mid-pilot point is no. In part, the use cases and business relationships could be improved if a sustainable service is identified. For instance, Wilson's Pharmacy provides many deliveries each week, but the majority of those deliveries include at least one prescription medication, which the City and community decided should not be delivered during the pilot period. It's possible we would see increased demand and a more meaningful service if prescription medications, along with over-the-counter goods and medications could be delivered to customers who already utilize Wilson's delivery service.

- **How accessible is the technology to target users? Are there identified barriers to use?**

  Again, current use of the PDD delivery is very low. The surveying and outreach to date has not determined whether low delivery numbers are due to lack of demand for the service or potential customers being unaware of the pilot service.

  Similar to the previous question, the pilot has highlighted the difficulty for small businesses and nonprofits to adopt a new technology or service, particularly for a limited pilot period. At this point in the pilot, it is unclear whether there is a lack of demand from customers or whether the barriers small businesses and nonprofits face in marketing and modernizing inventory tracking, result in lack of awareness of the delivery service and ease of use for customers, thus, lack of demand.

  For this delivery service to be successful and meaningful to small businesses and nonprofits, it seems that PDD operators will either 1) have to provide significant infrastructure and technical assistance to bring small businesses and nonprofits on board in a way that sets them up for success, or 2) partner primarily with large companies that have the staff, skills, and resources to integrate new technologies and services into their business models.

Appendix A

Description of External Incidents

09/02/2021 - A robot was vandalized by 2 pedestrians who blocked its path, picked up the robot and threw it on its side in the grass. The robot did not seem to have suffered any obvious damage. Kiwibot staff responded to the scene and spoke with pedestrians who did not provide a specific reason for interfering with the robot.

09/13/2021 - A robot was kicked by a pedestrian. The robot did not appear to have suffered any obvious damage. Kiwibot staff responded to the scene and spoke with the pedestrian after the person tried to kick the robot a second time. No clear reason provided for kicking the robot other than dislike of the technology.

09/14/2021 - A pedestrian picked up a robot and threw it near a dumpster. The flag of the robot was broken as well as the screen and internal components. Kiwibot did not catch the person in time to discuss.

09/21/2021 - A robot turned a corner around a table at the entrance of the Lawrenceville Farmers Market and ran into the leg and foot of a patron. Neither DOMI or Kiwibot staff witnessed the impact, but immediately responded to the incident. The person who was impacted assured no injury resulted and did not seek to file a written statement or formal report to DOMI. DOMI alerted Lawrenceville United and Lawrenceville Corporation of the incident that evening.

09/23/2021 - A pedestrian kicked a robot and kept walking. Kiwibot staff identified the person after receiving a description of the individual by the remote supervisor but did not proceed to engage with the person. The robot did not suffer any obvious damage.

09/29/2021 - At the intersection of N. Evaline Street and Penn Avenue (a marked intersection with traffic signals), a robot was crossing Penn Ave in the marked crosswalk with a "walk" signal. A motor vehicle on N. Evaline Street made a left onto Penn Avenue, with a green light, but failed to yield to the robot crossing the intersection. The vehicle hit the robot but continued down Penn Ave. A Kiwibot staff member was just around the corner and responded quickly to remove the robot from the intersection before any conflict or obstruction arose. The robot was inoperable, suffering internal damage; external case scratching; and motor, wheel, and hub damage.

09/30/2021 - A pedestrian kicked a robot and kept walking. The robot did not tip over but the internal component was damaged and required minor repairs.

10/01/2021: Pedestrians attempted to steal the flag from a robot. Flag was broken and required replacement.

10/01/2021 - Three pedestrians intentionally stood in front of the robot blocking it. One

person kicked the robot and the entire group kept walking. Robot did not suffer any obvious damage.

10/08/2021 - Pedestrian picked up a traffic cone and placed it on top of the robot. Robot did not suffer any obvious damage.

10/12/2021 - Pedestrian flipped over the robot. Flag broke and required replacement. Robot did not suffer any other obvious damage.