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FHWA Bicycle-Pedestrian Count

Technology Pilot Project

SUMMARY REPORT

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13. ABSTRACT

This report summarizes the Federal Highway Administration (FHWA)'s one-year Bicycle-Pedestrian Count Technology Pilot Project. The purpose of the pilot project was to increase the organizational and technical capacity of Metropolitan Planning Organizations (MPOs) to establish and operate effective bicycle and pedestrian count programs, and to provide lessons learned for peer agencies across the country. FHWA selected ten MPOs from across the country to participate in the pilot, and this report highlights their experiences with identifying count locations; selecting and installing count technology; and collecting and using the count data. The report concludes with the key benefits and lessons learned identified by the MPOs throughout the course of the project.

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FHWA would also like to thank the participating agencies and all of the staff that contributed to the implementation and reporting on the Count Technology Pilot. The participating agencies include:

- Fresno Council of Governments (Fresno, California)
- Greater Buffalo-Niagara Regional Transportation Council (Buffalo, New York)
- Indianapolis Metropolitan Planning Organization (Indianapolis, Indiana)
- Ohio-Kentucky-Indiana Regional Council of Governments (Cincinnati, Ohio)
- Memphis Metropolitan Planning Organization (Memphis, Tennessee)
- Palm Beach Metropolitan Planning Organization (Palm Beach County, Florida)
- Providence Metropolitan Planning Organization (Providence, Rhode Island)
- Puerto Rico Metropolitan Planning Organization (San Juan, Puerto Rico)
- Richmond Regional Transportation Planning Organization (Richmond, Virginia)
- Southeastern Wisconsin Regional Planning Commission (Milwaukee, Wisconsin)

Executive Summary

"MPOs without extensive previous multimodal counting experience were purposefully chosen in order to better understand and document challenges in "standing up" an ongoing counting program."

In May 2015, the Federal Highway Administration (FHWA) initiated a one-year Bicycle-Pedestrian Count Technology Pilot Project. The purpose of the pilot project was to increase the organizational and technical capacity of Metropolitan Planning Organizations (MPOs) to establish and operate effective bicycle and pedestrian count programs, and to provide lessons learned for peer agencies across the country.

For the pilot, FHWA selected 10 MPOs with populations of at least one million people that did not have a formal bicycle-pedestrian count program in place. MPOs without extensive previous multimodal counting experience were purposefully chosen in order to better understand and document challenges in initiating an ongoing counting program. MPOs were awarded $20,000 each to purchase and install bicycle and pedestrian counting equipment, to gather baseline count data, and to consider how these data may be used to support multimodal planning and project development. The following MPOs were selected to participate in the pilot project:

- Fresno Council of Governments (Fresno, California)
- Greater Buffalo-Niagara Regional Transportation Council (Buffalo, New York)
- Indianapolis Metropolitan Planning Organization (Indianapolis, Indiana)
- Ohio-Kentucky-Indiana Regional Council of Governments (Cincinnati, Ohio)
- Memphis Metropolitan Planning Organization (Memphis, Tennessee)
- Palm Beach Metropolitan Planning Organization (Palm Beach County, Florida)
- Providence Metropolitan Planning Organization (Providence, Rhode Island)
- Puerto Rico Metropolitan Planning Organization (San Juan, Puerto Rico)
- Richmond Regional Transportation Planning Organization (Richmond, Virginia)
- Southeastern Wisconsin Regional Planning Commission (Milwaukee, Wisconsin)

In addition to the formal project participants, representatives of other MPOs were invited to participate voluntarily in the technical support webinars. These other MPOs included Miami-Dade (FL) MPO, Metroplan Orlando (FL) MPO, Lee MPO (Fort Myers, FL), and the Washtenaw Area Transportation Study (Ann Arbor, MI).

This report summarizes the key elements of the pilot project, including insights into the successes and challenges encountered by the participating MPOs in implementing their own bicycle and pedestrian count programs. The project effort and results are reviewed in four sections:

1. Identifying count locations
2. Selecting counter technologies
3. Gathering and using counts
4. Review of lessons learned and program benefits

Identifying Count Locations

MPOs considered a number of factors when selecting their count locations such as current bicycle and pedestrian travel, adjacent land use, facility type, where recent projects have been completed, and where previous manual counts had been conducted. MPOs also consulted with local stakeholders and advisory committees to strategically pick count locations, and several noted that this input was very valuable in selecting count locations.

Using the factors outlined above, the MPOs selected a variety of count locations for their pilot projects. The Palm Beach MPO and Fresno Council of Governments (COG) rotated their counters throughout different areas of their regions, to cover a range of land uses, densities, and facility types. The Southeastern Wisconsin Regional Planning Commission (SEWRPC) took a different approach, and opted to complete all of its counts for the pilot project on regionally significant shared-use paths and trails. The Richmond Regional Transportation (TPO), Ohio-Kentucky-Indiana Regional Council of Governments (OKI), SEWRPC used the pilot as an opportunity to complete counts on recent or planned infrastructure projects, to better evaluate the impacts of these projects on bicycle and pedestrian travel.

Selecting and Installing Count Technology

With FHWA's guidance and technical support, MPOs researched and evaluated count technology options that would best support their selected count locations. MPOs considered variables such as cost, portability, ease of installation, manufacturer support, and recommendations of local partners to select counting technology. Most MPOs used passive infrared (IR) counters for pedestrian counts, and pneumatic tubes for bicycle counts. The Greater Buffalo-Niagara Regional Transportation Council (GBNRTC) took a unique approach to the pilot, and used pavement-embedded radar counters for its bicycle counts, and a fisheye camera system with video recognition for its pedestrian counts.

"MPOs considered variables such as cost, portability, ease of installation, manufacturer support, and recommendations of local partners to select counting technology."

MPOs encountered a few challenges with the installation of the counters, occasional damage to the counters and tubes, and challenges obtaining maximum data accuracy. As this was the first time that the MPOs had implemented automatic bicycle and pedestrian counts, many noted that it is important to allow for sufficient time to research count technology, go through procurement processes, and install the counters.

Collecting and Using Count Data

MPOs deployed the automatic counters around their regions for periods ranging from one week to six months. This allowed the MPOs to obtain baseline count data for a variety of locations. Most MPOs opted for automatic data uploads from their selected counter manufacturer, a service which costs more than manual retrieval, but can reduce burdens on staff time.

Some MPOs validated automatic count data with manual counts to identify outliers, and to create correction factors if necessary. Some MPOs observed over-counting and under-counting of bicyclists and pedestrians due to factors such as counter positioning and other technical requirements of the counters, but were able to correct these issues once they identified the sources of the problems.

Once data was collected and downloaded from counters, MPOs primarily used the data to establish baseline measures for count locations. MPOs analyzed the data to assess travel patterns by day of week and time of day. Some MPOs used before-and-after counts to look at impacts of new facilities for bicyclists and pedestrians. In addition, several MPOs indicated that they would coordinate the creation of shared databases for their partners and stakeholders to centralize count data across their regions.

Lessons Learned and Key Benefits

Throughout the course of the pilot, participating MPOs were able to establish baseline automated count programs, demonstrating that count programs can be initiated with a relatively small amount of funding and over a short amount of time. Although some of the MPOs faced challenges with installing the counters and with data accuracy of the collected counts, one of the key benefits of the project was the time saved over doing manual counts, and the ability to track continuous data over longer periods of time.

Once the data was collected and verified, some of MPOs reported on the benefits of having bicycle and pedestrian count data to support planning activities, such as using the data to support funding applications for bicycle and pedestrian infrastructure, developing bicycle and pedestrian plans, and pairing the count data with facility inventories to get a better understanding of non-motorized travel in their region.

Introduction

In May 2015, the Federal Highway Administration (FHWA) launched a one-year Bicycle-Pedestrian Count Technology Pilot Project. This research and technology deployment pilot project awarded 10 Metropolitan Planning Organizations (MPOs) $20,000 each to purchase and install bicycle and pedestrian counting equipment, generate baseline count data, and consider how this data can be used to support multimodal planning and project development.

The purpose of the pilot project is to increase the organizational and technical capacity of MPOs to establish and operate effective bicycle and pedestrian count programs, and provide lessons learned for peer agencies across the country. Quantitative data for bicycle and pedestrian planning is becoming increasingly important to support performance-based approaches. Once count data have been collected and maintained, examining trends and patterns in the pedestrian and bicycle count data can serve many purposes, including:

- Prioritizing project and funding decisions based on seasonal or year-round facility usage;
- Understanding broader safety concerns and exposure rates (number of crashes or other incidents per user, as opposed to just having the total number of crashes or incidents);
- Identifying appropriate facility design elements based on existing pedestrian and bicycle volumes, or on future target volumes; and
- Quantifying changes in bicycle and pedestrian mode shares, and associated public health and environmental benefits.

For the pilot, FHWA selected 10 MPOs with populations of at least one million people that did not have a formal bicycle-pedestrian count program in place. The following MPOs were selected to participate in the pilot project:

- Fresno Council of Governments (Fresno, California)
- Greater Buffalo-Niagara Regional Transportation Council (Buffalo, New York)
- Indianapolis Metropolitan Planning Organization (Indianapolis, Indiana)
- Ohio-Kentucky-Indiana Regional Council of Governments (Cincinnati, Ohio)
- Memphis Metropolitan Planning Organization (Memphis, Tennessee)
- Palm Beach Metropolitan Planning Organization (Palm Beach County, Florida)
- Providence Metropolitan Planning Organization (Providence, Rhode Island)
- Puerto Rico Metropolitan Planning Organization (San Juan, Puerto Rico)
- Richmond Regional Transportation Planning Organization (Richmond, Virginia)
- Southeastern Wisconsin Regional Planning Commission (Milwaukee, Wisconsin)

The selected agencies were granted $20,000 to fund up to 80 percent of the project's equipment procurement and program operation costs. Agencies provided a minimum of 20 percent of the project budget through non-Federal funds, though several agencies contributed a higher share.

Over the course of the pilot, FHWA conducted four technical assistance webinars with the participating MPOs, recordings and presentations from which are available on the **Pedestrian and Bicycle Information Center's website** (see Appendix 2 for a description of the webinars). MPOs also reviewed with additional resources on count programs, which are linked on the website and listed in Appendix 1 of this report.

In addition to the formal project participants, FHWA invited representatives of other MPOs to participate voluntarily in the technical assistance webinars. These other MPOs included Miami-Dade (FL) MPO, Metroplan Orlando (FL) MPO, Lee MPO (Fort Myers, FL), and the Washtenaw Area Transportation Study (Ann Arbor, MI).

This report summarizes the key elements of FHWA's Bicycle-Pedestrian Count Technology Pilot Project, and describes successes and challenges encountered by the MPOs who participated in the pilot. These experiences may be useful to other agencies seeking to begin automated bicycle and pedestrian count programs.

The document is divided into four sections:

- **Identifying Count Locations:** This section presents factors that MPOs considered when selecting their count locations such as current bicycle and pedestrian travel, adjacent land use, facility type (marked bicycle lane, shared lane markings, sidewalk, shared-use path, etc.), where recent projects have been completed, and where previous manual counts had been conducted.
- **Selecting and Installing Count Technology:** This section discusses the experiences MPOs had with the selection and installation of the counters, including reasons for selecting specific counter types.
- **Collecting and Using Count Data:** This section discusses how the MPOs collected and analyzed the data, identified errors or outliers, and summarized the bicycle and pedestrian count data to support their planning activities.
- **Lessons Learned and Key Benefits:** This section summarizes the lessons learned and key benefits from the count pilot. Implementing automated count programs for bicycle and pedestrian travel was a new area of data collection for the participating MPOs (some had previously gathered motorized counts).

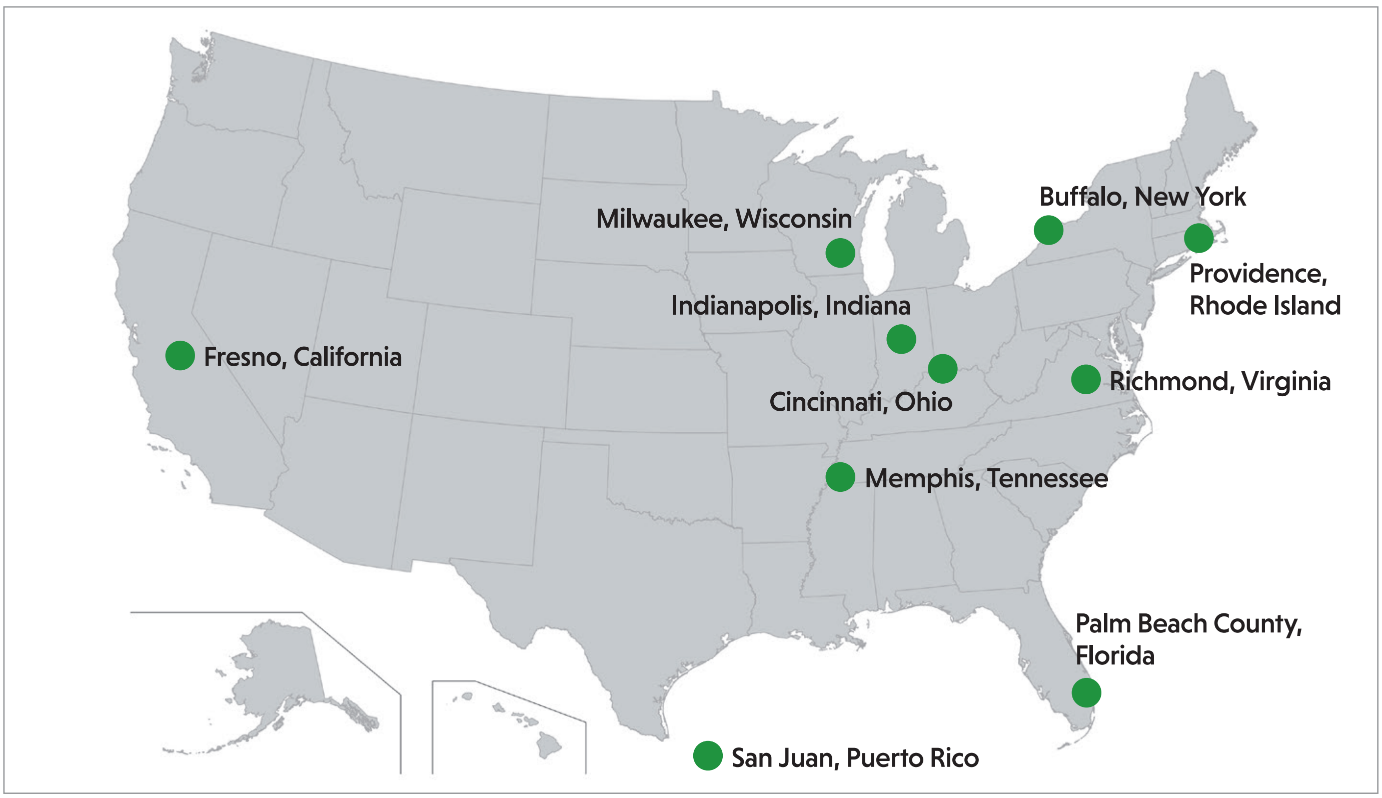


Figure 1. *Map showing the geographic distribution of the MPOs participating in the Pilot Count Project.*

Identifying Count Locations

As a first step in implementing their own programs, MPOs considered where to install counters. Generally, MPOs selected strategic count locations at places with significant bicycle and pedestrian traffic. Some MPOs, including the Palm Beach MPO and Fresno Council of Governments (COG), chose several locations in areas with a range of land uses to obtain baseline data and understand bicycle and pedestrian travel patterns across the MPO region. Other agencies tested fewer locations but collected data for longer periods of time. For example, Richmond Regional Transportation Planning Organization (Richmond TPO) focused their count project on a single area, while Palm Beach MPO rotated counters weekly for the maximum of 54 locations. In total, the MPOs conducted counts at over 170 locations during the pilot project.

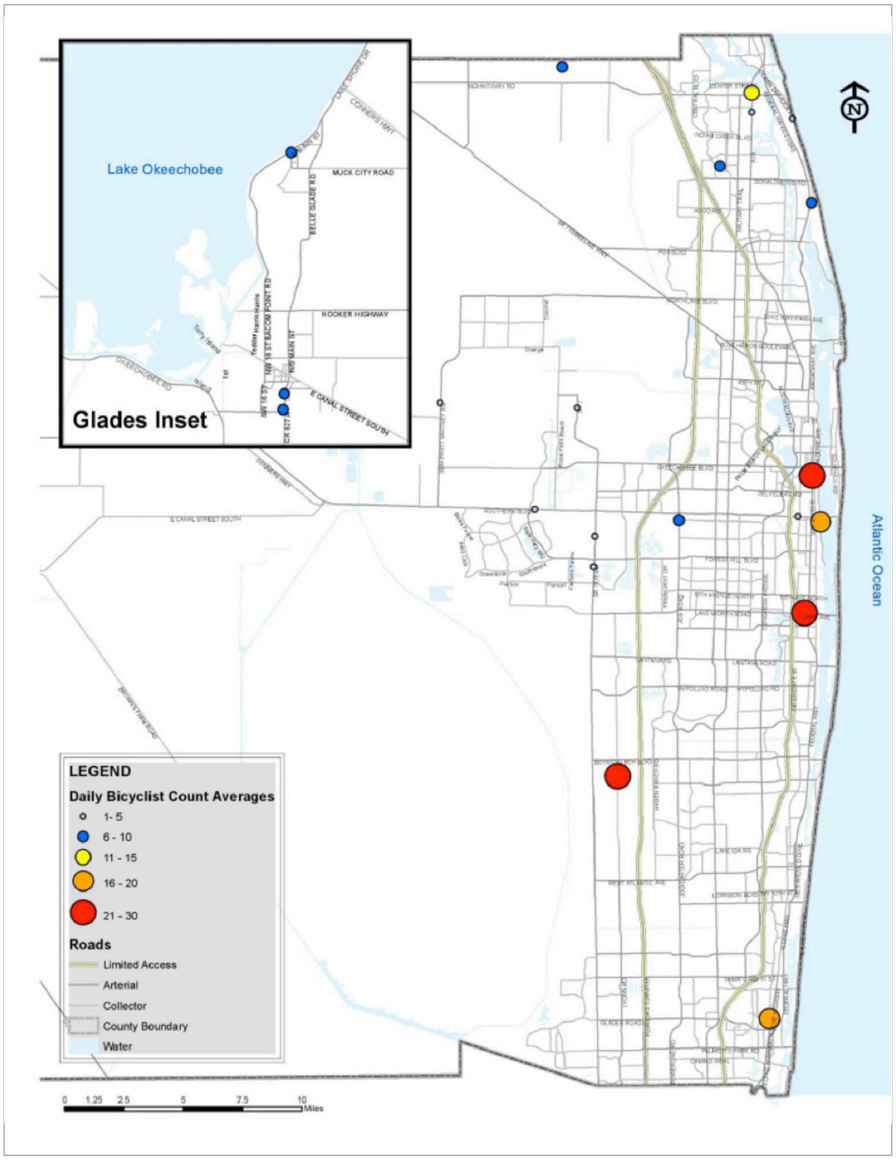


Figure 2. *The map shows a sub-set of count locations in the Palm Beach MPO and observed daily averages for bicycle travel. (Photo provided by the Palm Beach MPO.)*

In order to effectively select count locations across the region, MPOs considered a number of factors including:

- **Land use:** Several MPOs selected locations in both urban and suburban areas, which allowed them to understand bicycle and pedestrian travel patterns on different road types. Other MPOs primarily focused counts in central, urban areas on the streets and avenues most used by bicyclists and pedestrians. Ohio-Kentucky-Indiana Regional Council of Governments (OKI) in particular used the pilot to understand the number of trips going in and out of downtown Cincinnati. Other MPOs selected locations at strategic points in residential, educational, tourist, and recreational areas.
- **Facility type:** Pedestrian counters were placed primarily on sidewalks, but counts were also collected at marked crosswalks and on shared-use trails and paths. Bicycle counters were typically placed on streets with bicycle infrastructure, such as bike lanes or separated bike lanes. GBNRTC installed counters in corridors that had recently been striped with bike lanes as part of the City of Buffalo's Complete Streets initiative. Southeastern Wisconsin Regional Planning Commission (SEWRPC) placed counters on 11 regionally significant off-street paths to better understand use of their trail system in areas with different population densities and land uses.
- **Current bicycle and pedestrian travel:** In order to best understand current bicycle and pedestrian patterns, most MPOs selected locations where bicyclist and pedestrian volumes are already high. Automated counts at key locations in the pedestrian and bicycle network can provide insight into trends of walking and cycling, showing daily and seasonal peaks.
- **Previous count locations:** Some MPOs had previously completed manual counts and

chose to carry out the pilot counts at the same locations in order to establish continuing count programs and to validate automatic count data with manual counts.

- **Input from local stakeholders:** MPOs collaborated with local agencies in selecting count locations. For example, Fresno COG worked with five local agencies and one university, each of which proposed multiple count locations within their jurisdictions. Palm Beach MPO considered the input of its Bicycle, Trailways, and Pedestrian Advisory Committee. OKI considered feedback from citizens on areas considered unsafe or inconvenient for walking and biking.
- **Impacts of Recent Infrastructure Projects:** Some agencies used the pilot project as an opportunity to assess the impact of recent or planned projects. For example, Richmond TPO and OKI completed counts in areas with recently completed or anticipated road diet or traffic calming projects. Richmond TPO opted to complete counts on Floyd Avenue, before the construction of the Bike-Walk Boulevard, which is a 28-block traffic calming project that includes traffic circles, bump-outs, shared lane markings, and raised crosswalks. OKI selected a count location on a bridge slated for reconstruction, which could help the agency better understand bicyclist and pedestrian needs and assess the impact of rehabilitation. Additionally, the SEWRPC completed before and after counts to analyze the impact of a trail paving project.

Figure 3. *An example of a passive infrared pedestrian counter installed by SEWRPC on regional trails. (Photo provided by SEWRPC.)*

OKI installed pedestrian counters on several bridges, trails, and roads near downtown to better understand the number of trips going into and out of downtown, which can be analyzed alongside existing data on automobile traffic. Several sites were selected based on feedback from citizens and Ohio Department of Transportation, including multiple bridges slated for reconstruction.

Figure 4. *OKI's installation of a passive infrared counter near downtown Cincinnati for counting pedestrians. (Photo provided by OKI.)*

Figure 5. *The Palm Beach MPO counted bicyclists over a range of facility types, including a bicycle lane (top), a shared lane (middle) and in a shoulder (bottom). (Photos provided by the Palm Beach MPO.)*

Palm Beach MPO took a systematic approach to selecting count locations, placing counters in five area types based on zoning designations: recreational ridership locations (9 count locations), major commercial/office centers (6 count locations), minor commercial centers (21 count locations), schools/colleges/universities (19 count locations), and residential areas (13 count locations). Specific locations within these area types were recommended by Bicycle, Trailways, and Pedestrian Advisory Committee and included various bicycle and pedestrian facility types (i.e. shoulders, shared lanes, shared lane markings, sidewalks, shared-use paths). Palm Beach MPO will use the area and facility type designations to create factor groups (see textbox on page 15), which will eventually allow staff to project counts for other areas that are similar that do not have count data available. Palm Beach MPO opted to contribute additional funding for its local match, which enabled them to buy six bicycle and pedestrian counters each and complete counts at 54 locations by rotating the counters weekly.

LESSONS LEARNED // *Consult with partner agencies to help determine count locations*

MPOs noted that careful planning is necessary for site selection. In particular, it is important to pay attention to whether there are suitable places (i.e. poles) to install counters. Input from other agencies and community members was valuable in determining count locations that would be feasible and provide useful information for planning efforts.

Selecting and Installing Count Technology

With technical support and guidance from FHWA, MPOs researched count technology and selected counters from manufacturers that would be most suitable to their specific count program. Installation at count locations was facilitated by MPO staff, and those that involved local public works departments or local traffic engineers found that installation went more smoothly due to staff already having experience installing similar motorized counting equipment. The Memphis and Puerto Rico MPOs took an alternative approach to the count pilot, and opted to support their bicycle counting activities by contracting the count program design and operation.

Counter Selection

MPOs explored several possible types of technology and manufacturers, and considered the following factors in selecting counters:

- **Local conditions at count locations:** As they selected count technologies, MPOs considered matching counters to the conditions at each of their count locations. For example, SEWRPC focused on off-street paths and selected passive infrared counters due to their practicality for short-term counts on trails. Richmond TPO counted cyclists on two-way streets and opted for pneumatic tube counters that could complete bi-directional counts.
- **Cost:** Pedestrian counters varied in cost from $750 to around $4,000. Reasons for higher costs included more durable field installable cases and the automated upload of data into a web server. Bicycle counters cost about $1,650 per unit. MPOs also had to account for the installation costs. Some agencies were able to have counters installed without charge by local traffic engineers.
- **Ease of installation and portability:** Given that most of the MPOs had limited experience using count technology, they selected counters that would be relatively easy to install. Since several MPOs planned to use counters at multiple sites, all MPOs except GBNRTC, which installed permanent counters, opted for technology that was easily portable. For example, given the large size and varied land use of Palm Beach MPO, the agency identified portability as a main priority for selecting

Figure 6. A counter location on a trail in the Fresno area. (Photo provided by the Fresno COG.)

Figure 7. Fresno COG rotated their pneumatic tube counters (above) and passive infrared counters through a number cities and a university, making the portability of the counters important. (Photo provided by the Fresno COG.)

count technology. By selecting technology with the flexibility to move between sites, Palm Beach was able to complete multi-week counts at 54 locations.

- **Quality of technical support from manufacturer:** Given some challenges that occurred with installation and data retrieval, MPOs appreciated manufacturers that offered a good level of technical support. Some MPOs who had issues with damage to counters (discussed elsewhere) were able to use loaners during repair.
- **Method of data collection:** Data collection for the count technologies occurs either through manual on-site data retrieval or automatic data transmission. Manual retrieval occurs through Bluetooth transmission and user upload to the count platform. MPOs had to weigh the benefits of time saved with the additional cost of automatic data transmission.
- **Recommendations of State DOTs and other government agencies:** While some MPOs relied on staff or consultant's efforts to research count technologies, other MPOS, including the Providence MPO and SEWRPC, consulted with other government agencies with previous experience in this area to help inform their selection process. SEWRPC focused most of its efforts to collect counts in the six counties outside of Milwaukee County, since Milwaukee County and the City of Milwaukee already had five permanent count sites. For the six sites selected within Milwaukee County, however, the County benefitted as SEWRPC selected future potential count sites identified by Milwaukee County staff.

Range of Counter Technology Used

The purpose of the pilot project was to increase the capacity of MPOs to conduct automated multimodal count programs. Benefits to using automated counters over manual counts include 24/7 data collection, and greater coverage with less effort than manual counts. A number of different types of automated counters exist, but MPOs used counters with four types of sensors in the pilot project:

- Passive infrared (IR) devices
- Pneumatic tubes
- Radar sensors
- Video detection

These counters are typically installed on streets, sidewalks, and off-street paths. The majority of systems are able to upload data automatically via Bluetooth technology to nearby devices, and some support continuous data upload over cellular phone networks (though data charges may apply).

Pros and Cons of each Counter Technology

MPOs reported on their experiences with the cost, installation, data collection, and other issues they faced with the counter technology used for the pilot. The pros and cons of each technology type as documented by MPOs staff are described below:

Passive infrared counters

MPOs used passive infrared (IR) counters manufactured by Eco-Counters and TRAFx. Passive IR counters detect changes in energy (i.e. temperature) rather than changes in motion, sensing the infrared radiation (heat) of people going by **(NCHRP Report 797).** They are multi-purpose systems that can be used for pedestrians or bicyclists, but the technology cannot distinguish between people using the two modes. SEWRPC was the only MPO that used passive IR counters for both pedestrians and bicyclists, and this was because they counted combined volumes of users on off-street paths.

Some manufacturers sell passive IR counters packaged in a box for ease of installation. These boxes require an existing structure such as a light pole for installation. Placed in the weatherproof box, passive IR counters needed limited maintenance, have a long battery life, and were able to easily be moved between count locations. These counters are also able to operate with cloud-based data collection, which MPOs found saved a significant amount of time over manually collecting data by visiting the counter sites.

The biggest challenge to using passive IR counters is data inaccuracy due to users stopping in front of counters, multiple users passing counters simultaneously, and users not being counted if they divert around the counter. The sensor needs to be positioned strategically to ensure that only one type of travel is captured by the counter. MPOs found it essential to point pedestrian counters in urban areas away from the road to avoid accidental counting of cyclists and vehicles.

Pneumatic Counters

MPOs used pneumatic tube counters manufactured by Eco-Counters and JAMAR technologies for bicycle counts. Tube counters operate with an air switch that detects burst of air from passing vehicles. The tube is able to use pre-defined criteria such as axle spacing to determine what type of vehicle has passed, allowing the tubes to distinguish between cyclists and motorized vehicles. Pneumatic tube counters are able to count and measure the direction and speed of each user. Other benefits of using pneumatic tubes counters are the flexibility for short-term counts and ability to upload through a cloud-based system.

Tubes are typically installed on established bike paths or lanes perpendicular to traffic flow. Though tube counters are able to distinguish between cyclists and pedestrians, ideal placement adequately covers bicycle paths while avoiding the path of motor vehicles. Richmond TPO reported that cars backing into parking spaces and passing over the tubes exerted excessive pressure and caused damage. OKI reported damage to tubes by lawnmowers. Though generally easy to set up, some MPOs reported difficult installation due to the need for dry pavement for installation, and road closure requirements.

Like the passive IR counters, a challenge with tube counters is data accuracy. Richmond TPO reported

Technology	Manufacturers	Description	MPOs
Passive infrared counters	Eco-Counters, Traf-X	Passive infrared counters detect changes in energy (i.e. temperature/heat)	Fresno COG Indianapolis MPO OKI Palm Beach MPO Providence MPO Richmond TPO SEWRPC
Pneumatic tubes	Eco-Counters, JAMAR Technologies	Tube counters operate with an air switch that detects burst of air from passing bicycles	Fresno COG Indianapolis COG OKI Palm Beach MPO Providence MPO Richmond TPO Buffalo-Niagara RTC
MicroRadar sensors	Sensys Networks	Pavement-embedded bicycle counters for bicycle lanes	Buffalo-Niagara RTC
Video detection	GRIDSMART	Camera unit with independently licensed software module for pedestrian detection	Buffalo-Niagara RTC

Table 1. *Count technology used by MPOs in the pilot projects. For more information on count technology and sensor types, see* ***NCHRP Report 797.***

Figure 8. *Installation of a pneumatic tube counter by the Richmond TPO. (Photos provided by the Richmond TPO.)*

Figure 9. *While most MPOs used portable counters to collect data in a number of locations, GBNRTC opted for permanent pavement embedded bicycle counters to support its long range count program. (Photo provided by GBNRTC.)*

that the pneumatic tubes counters under-counted cyclists by more than 40% due to tube failure.

MicroRadar sensors

The GBNRTC opted to use pavement-embedded MicroRadar sensors manufactured by Sensys networks for its bicycle counts. The pavement-embedded sensors complement a new technology for traffic signal activation that the City of Buffalo recently installed, and this is part of the reason they opted to use pavement-embedded sensors. These sensors are wireless and use radar to distinguish cyclists from other road users. Radar pulses are transmitted and reflected off target objects and returned to the sensor. Bicycles are distinguished from motor vehicles based on the breadth of the returned signal. The in-ground sensors can provide both bicycle counts as well as parking space occupancy data.

LESSONS LEARNED // ***Ensure sufficient time and resources are allocated for selecting, procuring, and installing counters***

MPOs reported that they faced challenges with procurement and installation due to lack of staff time, lack of prior experience with count programs, and administrative barriers to procurement. Indianapolis MPO recommends agencies be sure to allocate sufficient staff time for both installation as well as administrative tasks such as accounting setup. Although they were expecting to have a single technician install the counters, in practice a team of two was necessary. Other MPOs discussed the difficulty of having to train not only project and operations staff, but also administrative and procurement staff.

Agencies that devoted more effort up-front to researching technologies and selecting count locations were better prepared to respond to challenges of installing and deploying counters. Some MPOs faced challenges with installation, including inability to install due to inclement weather and difficulties diverting road traffic during installation. MPOs that involved local traffic engineers had the most success with installation of their counters.

Some MPOs also noted that purchasing bicycle and pedestrian counters from the same manufacturer offers the benefit of only working with a single company instead of multiple companies, particularly in collecting and analyzing data in a single database. However, others decided to use multiple different manufacturers after considering relative costs and the technological capabilities desired for their particular count program.

Relatively inexpensive and easy to install, pavement-embedded sensors allowed GBNRTC to avoid the damage faced by other MPOs that used tube counters. The counters are installed close to the road surface and covered with a fast-drying adhesive for minimal lane closure time. Challenges to the technology included similar counting errors as other automated technology and need for dry pavement during installation of the counters.

Video detection

GBNRTC was the only MPO that opted to use video technology, selecting a portable fisheye camera manufactured by GRIDSMART. The camera was installed at the top of a pole and can view an entire intersection. Combined with an independently licensed pedestrian counting software, the camera can be configured in zones in order to detect between different sized objects and avoid zones where pedestrians are unlikely to be. Housed in a weather-protected unit, the camera is durable and weather-proof. The camera is relatively easy to install and move between sites, though GBNRTC selected one location for its pedestrian counts. Data can be retrieved manually or can be uploaded automatically with a Wi-Fi connection.

The GBNRTC took a unique approach in its selection of both pedestrian and bicycle counters. While most MPOs opted for automated box and tube counters, GBNRTC used a combination of pavement-embedded bicycle counters in marked bicycle lanes and a portable fisheye camera with pedestrian detection software. GBNRTC permanently installed pavement-embedded counters in order to have a continuous record of bicycles within specific bike lanes. These counters also allowed staff to avoid some of the issues other MPOs faced with damage to tubes installed on the pavement. Video technology with pedestrian detecting software allowed pedestrian zones to be designated to avoid false detection of other road users. Since the software detects rather than counts pedestrians, one downfall that is a group of three pedestrians may be "detected" as one object.

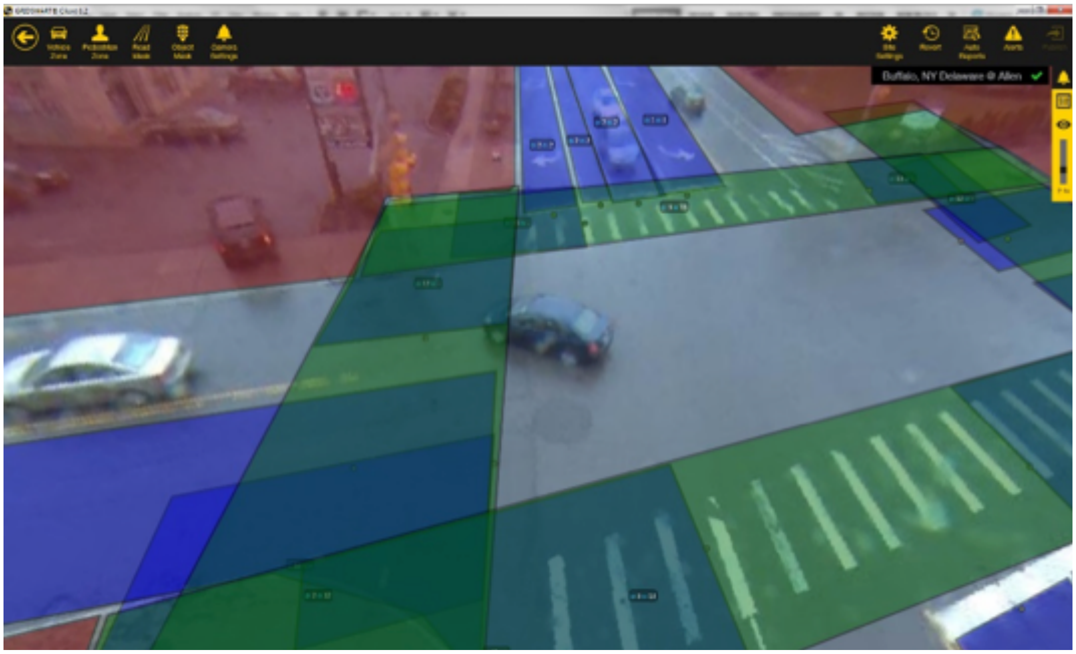


Figure 10. *Perspective from fisheye camera and pedestrian detection zones. (Photo provided by GBNRTC.)*

Figure 11. *A passive infrared counter installed by the Fresno COG. (Photo provided by the Fresno COG.)*

Figure 12. *GBNRTC's GRIDSMART portable fisheye camera is installed on top of the traffic light pole located on the left. (Photo provided by GBNRTC.)*

LESSONS LEARNED // ***Consider best count technology for short-term counts vs. long-term counts***

Most MPOs conducted short-term baseline counts, and rotated counters to various locations throughout the pilot. For short term counts, portability and ease of installation are important as counters are moved and installed at multiple locations. MPOs highlighted passive IR devices housed in boxes and pneumatic tube counters for portability and ease of installation for pedestrian and bicycle counts. Pneumatic tubes can be easily damaged, however, as they are installed on the pavement surface. The GBNRTC opted to use pavement embedded sensors, a similar system used for their vehicle counts, which are more suitable for long-term bicycle counts as they are installed permanently.

Collecting and Using Count Data

The length of time for pilot count locations ranged from one week to six months per location based on the MPO's specific goals for the pilot. Shorter counts allowed MPOs to collect baseline data for more locations and build momentum to establish permanent count programs. NCHRP Report 797 recommends that portable count data is needed for at least four to seven days in order to reduce errors in the extrapolation of the data to annual volumes. Longer-term counts increase accuracy by giving agencies more data to pull averages from, and accounting for variation due to weather, allowing agencies to better understand change over time.

Most of the MPOs selected count technology that automatically collected the data through a web- or cloud-based system. While it is more costly to have the data uploaded automatically into a web server, MPOs such as the SEWRPC reported that the automatic data upload feature was worth the savings of staff time for the pilot.

Once MPOs obtained the data, it was reviewed and analyzed by staff members, though some of the count technology manufacturers' web systems automatically produced charts and graphs. Data analysis efforts aligned with each MPO's purpose for the pilot. Some of the most common uses of the data were:

- Establishing baseline measures for count locations;
- Identifying patterns by time of day and day of week;
- Identifying safety concerns for bicyclists and pedestrians;
- Understanding impacts of infrastructure improvements; and
- Comparing with vehicle counts to understand modal share.

For example, SEWRPC used the count data to develop summary reports analyzing count volumes by area type, season, day of the week, temperature, and weather conditions. This detailed analysis allowed staff to understand possible reasons for outliers and to get a better understanding of count volumes. SEWRPC also conducted before and after counts to assess the impact of paving a trail.

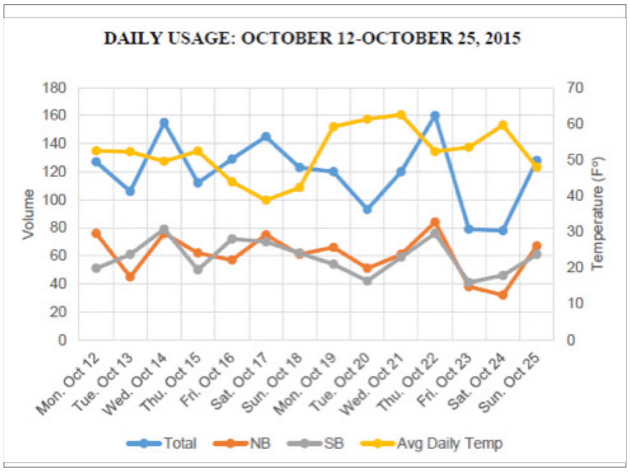
As previously discussed, there were challenges with data accuracy to varying degrees for each of the counters. Some MPOs cross-checked their data with in-person or video manual counts, which helped identify reasons for inaccuracy. Generally, correcting factors must be applied to automatic count data as part of the data cleaning and validation process, see Section 3.3.9 in the **NCHRP 797** report for more details.

The following pages contain examples of data outputs from SEWRPC, Fresno COG, and the Richmond TPO.

Factor Groups – "Factor groups are count sites that experience similar daily, monthly and annual pedestrian and bicycle traffic patterns" (NCHRP Report 797, pg 29). Factor groups can be used in to annualize short term count data for a location, based on data collected by permanent counters in similar locations. **NCHRP Report 797** and Chapter 4 of FHWA's **Traffic Monitoring Guide** provide detailed guidance on how to estimate factor groups. Using factor groups can help MPOs or local jurisdictions select count sites strategically, leveraging permanent counts collected at one site to estimate bicycle and pedestrian traffic at other place with similar characteristics.

KEY STATISTICS: MONDAY, OCTOBER 12 TO SUNDAY, OCTOBER 25, 2015

Statistic	Total	Northbound	Southbound
Two-week Period Total	1,675	851	824
October 12-Oct 18 Total	897	452	445
Mon-Fri Total	629	316	313
Sat-Sun Total	268	136	132
October 19-25 Total	778	399	379
Mon-Fri Total	572	300	272
Sat-Sun Total	206	99	107
Percent of Usage by Direction	- -	50.8	49.2
Weekly Average	838	426	412
Average on a Weekday	120	62	59
Weekend Average	119	59	60



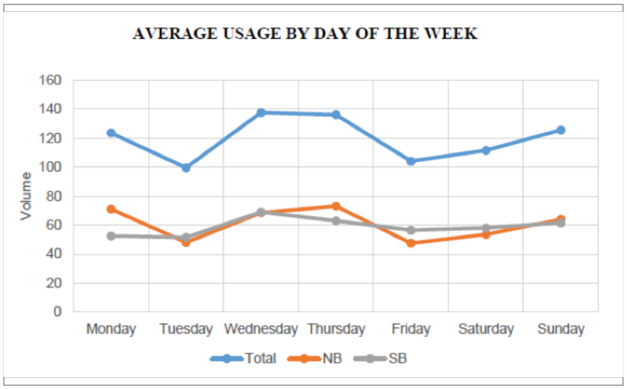


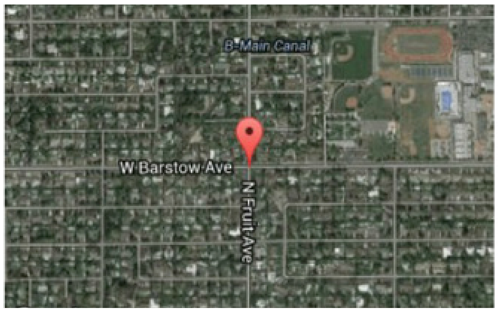
Figure 13. *The figures above show a passive infrared counter SEWRPC installed on a trail, and the associated data outputs from the trail. The count data is shown as key statistics, daily usage, and average by day of the week. (Photo and charts provided by SEWRPC.)*

LESSONS LEARNED // *Data accuracy*

GBNRTC, Fresno COG, Richmond TPO, OKI and the Palm Beach MPO reported challenges with data accuracy. MPOs adjusted in response to data accuracy concerns by repositioning counters or analyzing data to understand reasons for error. Several MPOs noted that in general the positioning of some of the counters was important to ensure that vehicles were not counted. Palm Beach MPO took an advanced approach by grouping count location types to extrapolate short-term counts for longer periods of time, which helps identify trends across different locations.

Figure 14. *A pneumatic tube counter installed on a trail for the Fresno COG count pilot. (Photo provided by the Fresno COG.)*

Equipped with cellular upload units, Fresno COG's counter boxes automatically uploaded to Eco-counter's server. Data was monitored and analyzed by staff, and data management accounts were also created for each city, county, and university that participated in the count project. Giving partner agencies direct access to the data allowed for greater collaboration, and California State University engineering students used the data from counters near their campus for a report comparing the automatic counts and manual pedestrian surveys.



Key Figures

- Total Traffic for the Period Analyzed: 1,625
- Daily Average : 116
- Busiest Day of the Week : Tuesday
- Busiest Days of the Period Analyzed:
    1. Tuesday September 22, 2015 (203)
    2. Friday September 25, 2015 (196)
    3. Tuesday September 29, 2015 (193)

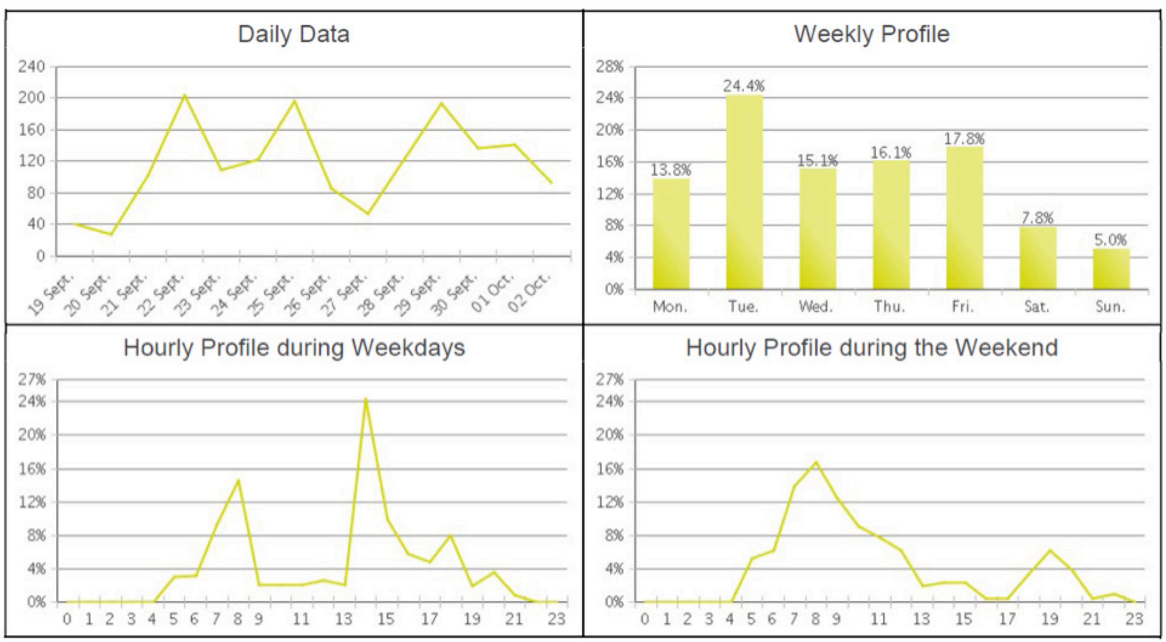


Figure 15. *Data downloads from the Eco-Counters used by the Fresno COG. (Images provided by the Fresno COG.)*

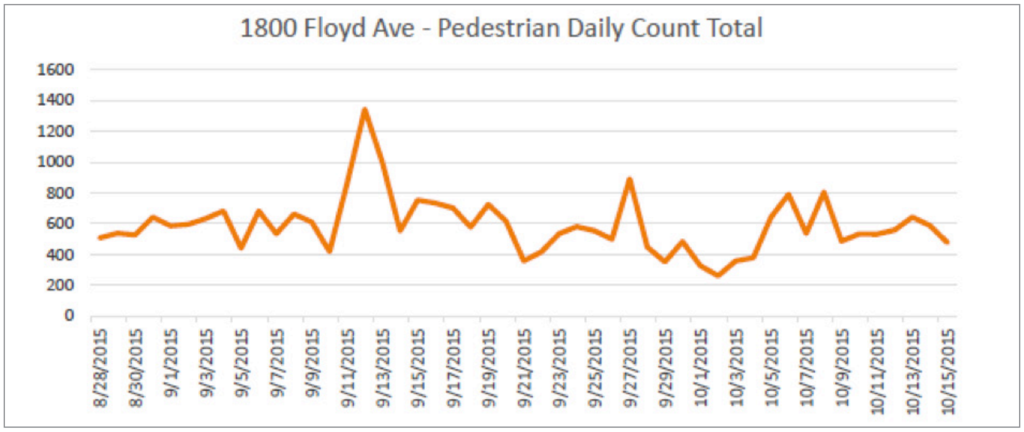


Figure 16. *Daily pedestrian counts from Richmond TPO's counters on Floyd Avenue. (Graph provided by the Richmond TPO.)*

Richmond TPO verified automated collection using Eco-Counters with manual counts in order to identify specific causes for count errors. For example, Richmond TPO found that the residential character of the neighborhood where the counters were placed led to over-counting in the mid-evening due to neighbors chatting on the side walk or children playing in the street. Richmond TPO also analyzed counts with hourly and weekend/weekday comparisons to identify patterns and outliers.

Pedestrians						
Time	Sept. 15, 2015		Sept. 16, 2015		Sept. 17, 2015	
	Manual	Auto	Manual	Auto	Manual	Auto
5:00:00 PM	13	11	22	12	11	11
5:15:00 PM	11	10	29	26	19	36
5:30:00 PM	22	32	12	46	10	25
5:45:00 PM	18	30	18	13	11	15
6:00:00 PM	13	20	28	33	20	29
6:15:00 PM	15	55	31	37	11	13
6:30:00 PM	21	33	18	54	24	86
6:45:00 PM	15	46	9	19	18	55
	128	237	167	240	124	270

Figure 17. *Chart showing comparisons of automatic and manual counts. (Chart provided by the Richmond TPO.)*

The table above from the Richmond TPO report shows the manual pedestrian counts used to validate automatic pedestrian counts. The most significant over-counting occurs in the evening (highlight in red), when neighbors are gathering on the sidewalks. The Richmond TPO noted in its report that this trend did present challenges for data collection, but also demonstrates that the sidewalk infrastructure is not used only for walking through the neighborhood, but that it is also an important gathering place for the community.

Lessons Learned

The goal of FHWA's Bicycle-Pedestrian Count Technology Pilot Project is to increase the capacity of the selected MPOs to deploy and implement an automated bicycle and pedestrian program. Throughout the course of the pilot, participating MPOs were able to establish baseline automated count programs, demonstrating that count programs can be initiated with a relatively small amount of funding over a short amount of time. The successes and challenges each MPO experienced with the pilot offers lessons learned for the MPOs going forward, as well as peer agencies. Key takeaways include:

Ensure sufficient staff time and resources are available for count programs

MPOs reported that it is important to allocate sufficient staff time and resources to initiate a count program, for all stages, including identifying count locations, researching count technology, installing the technology, and uploading and analyzing the data.

Involve partners in all steps of establishing and running a count programs

Involving partners in all steps of the process can help MPOs make the most of a counting program.

- **Selecting Count Locations:** Working with regional partners that have previously completed counts helps with site selection. Partners include other city agencies such as parks and recreation departments, other MPOs, and bicycle-pedestrian advocacy groups that had completed past counts. Furthermore, allowing the jurisdictions within the MPO to select sites was beneficial as these local staff have a more detailed understanding of conditions at count location.
- **Selecting Count Technology, Procurement, and Installation:** In addition to working with regional partners that have completed counts, involving local agencies with technical expertise facilitates the installation process.
- **Collecting and Using Data:** MPOs that shared access to the data with the various cities and counties that make up the MPO were able to collaborate more effectively to use the data towards future planning. For example, local university students and other academics can assist with a more detailed analysis of the data.

Select count technology best suited to identified count locations

Careful consideration and detailed research can help best match count locations to the most appropriate count technology. Key considerations when selecting count technology include cost, ease of installation and portability, length of count duration, level of support from manufacturer, and recommendations of partner agencies.

Validate automatic count data with manual spot checks

Data accuracy is a challenge for automated systems, and cross-checking data can be useful to understand the average margin of error. Data collected with automated counters can be cross-checked with manual counts, and also verified with video footage if available.

Key Benefits

MPOs found that the counter pilot project was effective at helping them learn about count technology and the deployment process. For many staff involved in the pilot, this was a new area of data collection, and the dedicated funding enabled them to become familiar with count technology and data collection for bicycle and pedestrian modes. The Puerto Rico and Memphis MPOs opted to contract their count programs, which is another option for MPOs to consider when weighing the resources necessary to start count programs.

One of the greatest benefits for MPOs that had already previously conducted manual counts was the amount of time saved and the ability to track data over longer periods of time. The pilot project built staff capacity to conduct more counts in the future, in both new locations and in the pilot locations to expand data collection.

Besides the benefit of time savings, automatic count data can enhance the multimodal planning process with valuable quantitative data that can be used for a variety of purposes. GBNRTC noted that the count data can help determine where walking and bicycling infrastructure is needed most, and help shape the planning and design of transportation corridors. SEWRPC noted that the data collected on its regional trails assists local communities with applications for the Transportation Alternatives Program (TAP) and Congestion Mitigation and Air Quality (CMAQ) funds. Count data collected during the pilot was combined with count data collected by Milwaukee County to help evaluate proposed trail underpasses as TAP funding candidates. The Fresno COG reported that the count data will complement its bicycle-pedestrian infrastructure inventory, and also its efforts in developing an Alternative Transportation Plan (ATP), in addition to being used to support funding applications. Fresno COG reported great interest from local jurisdictions in the region in learning more about implementing bicycle/pedestrian counts as a result of the pilot.

Figure 18. *One of GBNRTC's locations for pavement-embedded sensors for counting bicyclists. (Photo provided by GBNRTC.)*

Next Steps

The pilot program allowed MPOs to begin collecting a set of baseline data to understand bicycling and pedestrian frequencies at key locations. Some MPOs noted that they will continue to expand and improve their count programs. SEWRPC reported that it would like to further explore correction factors and conduct more manual counts to validate the automatic counts. SEWRPC will also explore using permanent count data collected by partners in similar locations to extrapolate short-term data collected during the pilot to annual estimates (see Factor Group text box above).

Several MPOs noted that that they will take on the role of centralizing count data collected across the region, in addition to conducting more counts. The Richmond TPO will take on the role of creating a count database to coordinate counts across the region. SEWRPC also noted that it will create a shared database to manage and centralize count data across Southeastern Wisconsin. The database will be accessed through the Eco-Counter website, and partners will have access to upload count data and download count data collected by partners. In addition, OKI plans on creating online maps where count data will be publicly available.

Appendix 1 – Technical Resources

Project Technical Support Website:

http://www.pedbikeinfo.org/countpilot

Bicycle and Pedestrian Count Project Guides and Resources

- Conducting Bicycle and Pedestrian Counts Manual, Los Angeles Bike Count Data Clearinghouse: **http://www.bikecounts.luskin.ucla.edu/**
- Initiative for Bicycle and Pedestrian Innovation (IBPI, Portland State University) Guide to Pedestrian and Bicycle Count Programs: **http://www.pdx.edu/ibpi/count**
- FHWA's Transportation Planning Capacity Peer Program, North Central Texas Council of Governments Peer Exchange on Bicycle and Pedestrian Count Programs: **http://www.planning.dot.gov/Peer/Texas/arlington_5-29-13.pdf**
- FHWA's Traffic Monitoring Guide, Chapter 4: Traffic Monitoring for Non-motorized Traffic: **http://www.fhwa.dot.gov/policyinformation/tmguide/**
- NCHRP Report 797, Guidebook on Pedestrian and Bicycle Volume Data Collection, available from TRB: **http://www.trb.org/Main/Blurbs/171973.aspx**

Appendix 2 – Technical Webinars

FHWA conducted four technical assistance webinars with the participating MPOs, recordings and presentations from which are available on the Pedestrian and Bicycle Information Center's **website.**

May 29, 2015: Technical Assistance Webinar No. 1

- Topics include site selection, obtaining permissions, sampling plan, and installation issues.

Sept. 11, 2015: Technical Assistance Webinar No. 2

- This technical assistance webinar revisited site selection and installation and covered the new topics of device calibration (manual counting) and managing count data including formatting, transmission, storing, and cleaning collected count data.

Nov. 20, 2015: Technical Assistance Webinar No. 3

- This technical assistance webinar presented information on cleaning and analyzing the collected data. There was also an opportunity for discussion among the pilot agencies on challenges and successes in starting an automated count program.

March 15, 2016: Technical Assistance Webinar No. 4

- This webinar presented examples from across the country to show the range of analyses that are possible using count data. The webinar includes beginner and advanced techniques that may be used for purposes including developing trend estimates or modeling.

Appendix 3 – MPO Pilot Summaries

Fresno Council of Governments (Fresno, California)

Fresno Council of Government (COG) purchased four passive infrared and four pneumatic tube counters, and rotated the counters through 23 locations in five different city/county agencies, and at one university. The counts were collected at a range of land use and facility types, including urban, suburban and rural streets, multi-use trails, and a downtown pedestrian mall. Fresno COG collected the count data through automatic uploads to a common server used by city/county agencies, and the university. Fresno COG used video footage as well as manual counts to validate the data from the counters. The validation process revealed discrepancies between the manual and automatic counts due to people stopping in the front of the counters, and from multiple people passing at once. The validation process helped inform Fresno about best practices for positioning the counters to collect accurate counts. Overall, the pilot project helped increase interest among the local agencies in counting, letting them gain experience with counting technology, and enhanced the multimodal data available for future plans and projects.

Greater Buffalo-Niagara Regional Transportation Council (Buffalo, New York)

The Greater Buffalo-Niagara Regional Transportation Council (GBNRTC) operates a counting program for vehicles, counting about 1/3 of the roadway system per year. As part of the that program, the automated vehicle counts are paired with eight hour manual turn counts at a single intersection, which also includes bicycle and pedestrians counts. GBNRTC used the count pilot as an opportunity to expand on its manual counts, and installed 12 pavement embedded sensors for bicycle counts and one fisheye camera with pedestrian detection software for pedestrian counts. The automated counters will allow GBNRTC to evaluate the use of complete streets treatments: the pavement embedded bicycle counters were installed in recently created separated bicycle lanes and the fisheye camera was installed at a clearly marked crosswalk. The use of this new technology allowed GBNRTC to greatly increase the amount of data collected, which will help planners determine where investments would be most effective.

Indianapolis Metropolitan Planning Organization (Indianapolis, Indiana)

The Indianapolis Metropolitan Planning Organization (MPO) purchased three pneumatic tube bicycle counters and three passive infrared pedestrian counters for the pilot. The MPO installed the counters at strategic locations where partners were already completing counts so that the data could compared for accuracy. Indianapolis faced challenges with procurement and staff availability, but found the pilot useful for learning more about the count technology and deployment.

Ohio-Kentucky-Indiana Regional Council of Governments (OKI) (Cincinnati, Ohio)

The Ohio-Kentucky-Indiana Regional Council of Governments (OKI) used the count pilot as an opportunity to try out three different types of counters: two different types of passive infrared counters, and pneumatic tube counters. OKI rotated the counters through 11 different locations. The passive infrared pedestrian counters were deployed in seven locations, including near the Great American Ballpark in Cincinnati, on two bridges slated for reconstruction, and on streets near downtown Cincinnati. Only one type of the pedestrian counters used by OKI came in a weatherproof casing, making this type counter much easier to rotate to different locations. The bicycle counters were installed in four locations, including a street that recently had some parking removed as part of a road diet. OKI plans to make the data available to the public on its website.

Memphis Metropolitan Planning Organization (Memphis, Tennessee)

The Memphis Metropolitan Planning Organization (MPO) plans to install automated counters in the same locations that the MPO conducted manual counts in 2014. The Memphis MPO took an alternative approach to the count pilot, and opted to support their counting activities by contracting the count program design and operation to a consultant.

Palm Beach Metropolitan Planning Organization (Palm Beach County, Florida)

The Palm Beach Metropolitan Planning Organization (MPO) purchased six passive infrared counters, and six pneumatic tube counters for bicycle counts. The MPO deployed the counters to over 50 count locations over the year pilot, counting for about a week at each location. The MPO consulted with its advisory committees to strategically select count locations based on zoning designations and facility types. By conducting counts in a variety of locations, the MPO was able to obtain a broad understanding of bicycle and pedestrian behaviors in diverse built environments.

Providence Metropolitan Planning Organization (Providence, Rhode Island)

Through the count pilot project, the Providence Metropolitan Planning Organization (MPO) gathered baseline data for a future permanent non-motorized traffic count program. The MPO deployed three passive infrared pedestrian counters, and three pneumatic tube counters at a total of seven locations with high levels of pedestrian and bicycle traffic. While Providence MPO noted challenges with procurement as well as educating staff members about how to implement a non-motorized count program, benefits of the pilot included increased inter-agency collaboration and increased capacity for implementing a permanent program.

Puerto Rico Metropolitan Planning Organization (San Juan, Puerto Rico)

The Puerto Rico Metropolitan Planning Organization (MPO) experienced administrative delays in procuring technology, and will be contracting out the counting pilot to a consultant. The MPO plans to have the initial count locations in areas that are part of the bicycle and pedestrian network.

Richmond Regional Transportation Planning Organization (Richmond, Virginia)

Following manual counts done by a local non-profit, the Richmond Regional Transportation Planning Organization (TPO) collected data for about two months using automated counters along Floyd Avenue, which is now reconstructed as a Bike-Walk boulevard. Using passive infrared counters and pneumatic tube counters, the Richmond TPO collected automated count data, which they compared to manual counts. The TPO faced some challenges with installation and damage to counters, but overall, the pilot allowed Richmond to kick-start a regional effort to collect more bicycle and pedestrian data. Going forward, the Richmond TPO will encourage local agencies to conduct more automatic counts, while the TPO will start a database to centralize counts from across the region.

Southeastern Wisconsin Regional Planning Commission (Milwaukee, Wisconsin)

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) purchased three passive infrared counters for counting bidirectional, combined bicycle and pedestrian traffic. SEWRPC completed bicycle and pedestrian counts at 29 locations along regional trails in the Milwaukee area. SEWRPC analyzed the count data along with variables such as weather, temperature, days of the week, area type, and season. The MPO also assessed before-and-after data following a trail reconstruction. SEWRPC was able to provide count data to its partners to be used in grant applications for trail improvements.

Appendix 4 – MPO Contacts

MPO Bicycle and Pedestrian Count Technology Deployment Pilot Project Contact List

Buffalo, NY

Amy Weymouth-Michaux
aweymouth@gbnrtc.org
438 Main Street
Buffalo, NY 14202
(716) 856-2026

Cincinnati, OH

Summer Jones, Transportation Alternatives Coordinator
OKI Regional Council of Governments
sjones@oki.org
720 East Pete Rose Way, Suite 420
Cincinnati, Ohio 45202
(513) 621-6300

Fresno, CA

Kai Han, TE, Senior Regional Planner
Fresno Council of Governments
khan@fresnocog.org
2035 Tulare Street, Suite 201
Fresno, CA 93721
(559) 233-4148 ext. 206

Indianapolis, IN

Andrew D. Swenson | Principal Planner |Data Section
Indianapolis Metropolitan Planning Organization
andrew.swenson@indympo.org
200 East Washington Street, Suite 1922
Indianapolis, IN 46204
(317) 327-5132

Memphis, TN

Nat Heyward, Transportation Planner
Memphis Urban Area Metropolitan Planning Organization (MPO)
Nathaniel.Heyward@memphistn.gov
125 N. Main Street,Suite 450
Memphis, TN 38103
(901) 576-7273

MPO Bicycle and Pedestrian Count Technology Deployment Pilot Project Contact List (continued)

Milwaukee, WI

Christopher T. Hiebert, P.E., Chief Transportation Engineer
Southeastern Wisconsin Regional Planning Commission
chiebert@sewrpc.org
W239 N1812 Rockwood Drive
P.O. Box 1607
Waukesha, WI 53187-1607
(262) 547-6721

Palm Beach, FL

Franchesca Taylor, AICP, Senior Planner
Bicycle, Pedestrian and Transportation Demand Management Coordinator
Palm Beach MPO - Transportation Planning for the Palm Beaches
FTaylor@PalmBeachMPO.org
2300 N Jog Road, 4th Floor
West Palm Beach, FL 33411
(561) 478-5713 (direct); (561) 684-4170 (main number)

Providence, RI

Chris Witt, Principal Planner
Rhode Island Statewide Planning Program
chris.witt@doa.ri.gov
One Capitol Hill
Providence, RI 02908
(401) 222-7901

Richmond, VA

Sarah Rhodes, Principal Planner
Richmond Regional Transportation Planning Organization
srhodes@richmondregional.org
9211 Forest Hill Avenue, Suite 200
Richmond, VA 23235
(804) 323-2033 ext.115
San Juan, Puerto Rico
Martha Bravo Colunga, PPL, Bicycle and Pedestrian Coordinator

Strategic Planning Office

Puerto Rico Highway and Transportation Authority
mbravo@dtop.gov.pr
(787) 721-8787 Ext. 1638

U.S. Department of Transportation

Federal Highway Administration