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Using Co-Creation to Deliver Equity in Smart City Projects

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ABSTRACT

While traditional infrastructure projects have sometimes amplified equity issues in communities, smart cities and intelligent transportation systems (ITS) have frequently sought to improve the traveler experience and connect neighborhoods, jobs, services, health care and entertainment. Recent smart city and ITS projects are now specifically measuring the community impact in terms of opportunity and equity, as Smart Columbus demonstrated as they completed their program in May 2021. Realizing these impacts begins way before the project, with community engagement and involvement to achieve co-creation and community ownership, interest and adoption of emerging technologies once the project is complete. Both technology and traditional infrastructure projects are now leveraging the co-creation approach as it is directly linked to equity outcomes. This paper summarizes the deployment approach used by the Smart Columbus Program Management Office (PMO), specifically discussing the communications strategy, audiences and toolkit that were developed and applied across eight projects, which ranged from a community wide operating system to human services applications for trip planning, parking, and mobility to emerging technologies including connected and automated vehicles. The paper provides details on the different skills and tools that were used across the program and why, and a comparison of when they were applied and their performance in terms of the impact on user needs, project adoption and results. Opportunity outcomes and results are also discussed at the program level.

INTRODUCTION

While traditional infrastructure projects have sometimes amplified equity issues in communities, smart cities and intelligent transportation systems (ITS) have frequently sought to improve the traveler experience and connect neighborhoods, jobs, services, health care and entertainment. Recently, smart city and ITS projects are specifically measuring the community impact in terms of opportunity and equity, as Smart Columbus demonstrated as they completed their program in May 2021. Realizing these impacts begins way before the project, with community engagement and involvement to achieve co-creation and community ownership, interest and adoption of emerging technologies once the project is complete. Both technology and traditional infrastructure projects are now leveraging the co-creation approach as it is directly linked to equity outcomes. This paper summarizes the deployment approach used by the Smart Columbus Program Management Office (PMO), specifically discussing the communications strategy, audiences and toolkit that were developed and applied across eight projects, which ranged from a community wide operating system to human services applications for trip planning, parking, and mobility to emerging technologies including connected and automated vehicles. The paper provides details on the different skills and tools that were used across the program and why, and a comparison of when they were applied and their performance in terms of the impact on user needs, project adoption and results. Opportunity outcomes and results are also discussed at the program level.

BACKGROUND

The U.S. Department of Transportation's (USDOT) Smart City Challenge (SCC) was created in 2015 to demonstrate and evaluate a holistic approach to using new technologies to improve surface transportation performance within a midsized city, and integrating this approach with other smart city domains such as public services, health, safety and energy. Seventy-eight cities applied for the SCC funding, with seven cities selected as finalists. After a nine-month process, USDOT chose Columbus, Ohio, as the SCC winner in June 2016, with the Cooperative Agreement signed in August 2016. In the application, the City of Columbus described managing aging infrastructure while striving to provide an improved quality of life for a growing population. The City sought to create opportunities for economic development and job creation through the SCC, using transportation improvements to improve mobility and provide ladders of opportunity for residents to better access jobs, fresh food, services, education, health care and recreation. By implementing the Smart Columbus Program, the City began empowering residents to live their best lives through the application of responsive, innovative and safe emerging technologies.

The City proposed a concentration of demonstrations in its Linden neighborhood because the future of Columbus – and cities like it nationwide – depends on vibrant, thriving neighborhoods. Opportunity neighborhoods such as Linden (that is, lower income and underserved communities) exist throughout the United States and share many of the same challenges. By deploying smart technology solutions in Linden, the City sought to demonstrate how next generation transportation technologies can address some of the damage from decades of redlining, disinvestment, and isolation caused by interstate construction. The program aimed to do that by collaborating directly with the people who reside in Columbus' neighborhoods. Participation was key to success, and Linden residents were ready to work alongside City staff to show how mobility innovations can be deployed in an equitable way, so other neighborhoods across the United States that look like Linden could benefit in the future.

Program Overview

The City sought to achieve these goals through deploying its final project portfolio, consisting of the following eight projects:

- **Smart Columbus Operating System (SCOS)** – The SCOS is a platform designed for big data, analytics, and complex data exchange. It collects, manages and produces over 2,000 datasets, including data from each of the Smart Columbus projects, and provides multiuser access to aggregate, fuse and consume data.

- **Connected Vehicle Environment (CVE)** – CVE deployed connected vehicle technology at 85 intersections and in over 1,000 vehicles across four City corridors. The connected vehicle devices enabled vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, supporting safety and mobility applications that provide alerts to drivers, coordinate signal priority and preemption at

intersections for priority vehicles, and provide data to the City and the Central Ohio Transit Authority (COTA).

- **Multimodal Trip Planning Application (MMTPA)** – MMTPA project created a website and smartphone app called Pivot, which allows travelers to request and view multiple-trip itineraries and access transportation options such as transit, ride-hailing services and bike- and scooter-sharing.

- **Mobility Assistance for People with Cognitive Disabilities (MAPCD)** – MAPCD demonstrated an innovative smartphone app – WayFinder by AbleLink – for older adults and people with cognitive disabilities to facilitate independent travel via the fixed-route bus system. The app features highly accurate, turn-by-turn navigation that is sufficiently intuitive for users who have cognitive disabilities.

- **Prenatal Trip Assistance (PTA)** – PTA created a call center, smartphone app and website (called Rides4Baby) for use by pregnant individuals to schedule flexible, reliable, two-way transportation to medical-related services. The project delivered non-emergency medical transportation (NEMT) services through Medicaid Managed Care Organizations (MCOs).

- **Smart Mobility Hubs (SMH)** – SMH consolidated transportation resources and offered access to comprehensive trip-planning tools at six designated locations. These hubs are primarily located adjacent to existing transit center facilities and provide physical space for the consolidation of services such as ride-hailing and bike-, scooter- and car-sharing. Interactive kiosks and public Wi-Fi allow the traveler to view real-time travel information and book multimodal trips via the Pivot app.

- **Event Parking Management (EPM)** – EPM expanded the features of the City's ParkColumbus app and developed a website to integrate parking information from City-owned parking meters and multiple parking facilities into a single availability and reservation services solution. This allows travelers to search for and reserve parking in advance or on the go. More direct routing of travelers during large events is expected to reduce congestion during those times. The solution also identifies the current projected on-street parking availability near users' target destinations using predictive analytics.

- **Connected Electric Autonomous Vehicles (CEAV)** – CEAV deployed automated shuttles that operated in mixed traffic, interacting with other vehicles, bicyclists and pedestrians. The project conducted two demonstrations: one in Downtown Columbus and one in the Linden community.

Program Outcomes

To direct the vision of Smart Columbus and keep the purpose of the projects true to the original intent, the program identified the following six outcomes, or broad statements about positive societal impacts. These outcomes represent the many potential indicators that make a city a great place to live, work or visit, and they were at the forefront of each project's development and demonstration.

1. **Safety:** Three objectives related to increasing drivers' awareness of signals and other vehicles in the corridors were evaluated for the CVE project.

2. **Mobility:** Eight objectives were evaluated at the program level and for the CVE, MMTPA, SMH, MAPCD, PTA and CEAV projects. The Mobility objectives focused on how enhancing mobility applies to all transportation modes, and how making these modes more accessible and usable with real-time traveler information and innovative technologies impacts individual mobility.

3. **Opportunity:** Five objectives were evaluated at the program level and for the MMTPA, MAPCD, PTA, CEAV projects. Opportunity objectives focused on improved access to transportation options for Columbus residents, including those in underserved communities, by connecting them to employment, education, health care and other services while increasing transportation network use by bringing together available services and users.

4. **Environment:** One objective was evaluated at the program level, with the CVE, MMTPA and EPM projects contributing (and assessed as a group). The Environment objective to reduce

transportation's negative impacts on the environment by implementing advanced technologies and policies that support a more sustainable transportation system.

5. **Agency Efficiency:** Five objectives were originally applied to the SCOS and MAPCD projects; however, the MAPCD objectives were not evaluated due to a change in participant recruiting. The Agency Efficiency objectives focused on improving agencies' ability to provide services to residents through advanced technologies that enabled easier access to real-time data, streamlined internal processes, and improved information-sharing.

6. **Customer Satisfaction:** Seven objectives were evaluated for the SCOS, MMTPA, SMH, PTA, EPM, and CEAV projects. The Customer Satisfaction objectives focused on providing services embraced by the community and improving the user experience of transportation and community services through integrated data exchange and advanced technologies.

After almost five years, the Smart Columbus Program was found to have successfully or partially achieved 22 of the 29 objectives identified for the program. Performance on the remaining seven objectives was inconclusive primarily due to small sample size or COVID-19 impacts, not project or application failures (Figure 1).

Deployment Approach

The Smart Columbus deployments delivered quantifiable outcomes that sought to serve the community. While the COVID-19 pandemic presented challenges to implementing the final portfolio of eight projects, these deployments still delivered measurable progress against all of Columbus' six intended outcomes described previously.

Throughout these challenges, the City relied on comprehensive stakeholder collaboration to ensure that they remained true to the founding concept of focusing on the end users – the residents of Columbus. As the program concluded, it also became apparent that this foundation was key to the residents' acceptance of emerging technology and the achievement of opportunity and equity outcomes. From the beginning, the City worked with the following guiding principles when designing, deploying, and operating the Smart Columbus Program. These principles were instrumental in helping the PMO identify and manage the many challenges that emerged over the nearly five-year program across the various projects.

- **Human-Centered** – Intended-use cases and end-user engagement such as surveys, interviews, working groups, beta testing and the participation of community liaisons, guided

OUTCOMES →	SAFETY	MOBILITY	OPPORTUNITY	ENVIRONMENT	AGENCY EFFICIENCY	CUSTOMER SATISFACTION
CONTRIBUTING PROJECTS	→ CVE	→ **SMART COLUMBUS PROGRAM** → MMTPA → SMH → MAPCD → PTA → CEAV	→ **SMART COLUMBUS PROGRAM** → MMTPA → MAPCD → PTA → CEAV	→ **SMART COLUMBUS PROGRAM** *Projects assessed as a group:* → CVE → MMTPA → EPM	→ SCOS → MAPCD *MAPCD project assessed as "inconclusive; because participants were not existing paratransit users*	→ SCOS → MMTPA → SMH → PTA → EPM → CEAV
PROGRAM FINDINGS	*Not applicable; only CVE project evaluated for Safety benefits*	Improved ease of transferring modes Modest reduction in traffic delays and traffic volume observed during peak weekday hours	Significantly easier trip planning post-Smart Columbus Accessibility area expanded by 30 minutes from Linden Transit Center Established access to 20,000 more jobs and 3,000 more health care services	Inconclusive due to small sample sizes and impact of COVID-19 pandemic on travel behavior Projects assessed as a group have potential to reduce greenhouse gas emissions post-pandemic	*Not applicable; only SCOS and MAPCD projects evaluated for Agency Efficiency benefits*	*Not applicable; Customer Satisfaction evaluated only at project level*
HIGHLIGHTS OF PROJECT OBJECTIVES ACHIEVED	**CVE:** » Emergency response times (average speed and travel time) improved by average of 1.64% when signal preemption granted; improvement of up to 5.2% noted » Vehicle speeds reduced by average of 2.3 mph when approaching red light » School zone speed limit compliance improved from 18% to 56%	**EPM:** Significant improvement in mean response time taken to find parking for leisure activities **MAPCD:** Shifted 82 trips from the personal vehicles of caregivers to public transit **CEAV:** 265 walkups at the Rosewind stop	**MMTPA:** Significant increase in access to health care and entertainment **MAPCD:** Participants reported sense of greater independence **PTA:** Percentage of participants who did not take NEMT trips decreased from 44% to 19% **CEAV:** Over 130,000 meals transported to neighbors in Linden	**PAUL G. ALLEN FAMILY FOUNDATION GRANT:** » 3,458 EVs purchased » 914 charging ports installed » 18.6 million people educated about Smart Columbus Program	**SCOS:** » Over 800 agency-related datasets » 222,685 downloads » 67,156 queries » 59% of users rated their experience of finding intended data as good to very good » Agency users cited improved data-sharing ability » Over 60% of users said experience accessing and using data was good to very good	**SCOS:** Over 70% rated various functions good or very good **MMTPA:** Over 97% found Pivot easy or very easy to use **PTA** and **CEAV:** 90% were satisfied, very satisfied or extremely satisfied **EPM:** Over 30,000 app downloads; 82% users say they will use new app features

FIGURE 1: Highlights of performance measures results. Source: City of Columbus

every technology deployment. This enabled the teams to solve real-world community challenges. For example, personal preferences stated within the Pivot app informed route design, and the mobility needs of specific individuals guided design of the PTA and MAPCD projects, with PTA providing NEMT for pregnant individuals, and MAPCD empowering individuals with cognitive disabilities to travel independently via public transit.

- **Replicable** – The Smart Columbus Program established governance and standards for the projects, so that other cities could replicate the technology solutions. For example, the code developed for the SCOS – a scalable data-management platform designed to serve the needs of public agencies, researchers, entrepreneurs and the private sector – is open source and accessible on GitHub.com.

- **Collaborative** – Partners from throughout the community, including COTA, the Ohio Department of Transportation (ODOT), MORPC, The Ohio State University (OSU) and companies from the region's private sector helped to advise the development, implementation and sustainment of the projects within the portfolio. Coordination with efforts and projects taking place elsewhere in the region, or through other funding sources, were leveraged and brought together for the benefit of all stakeholders and projects. As an example, the CVE project continuously coordinated with ODOT and the 33 Smart Mobility Corridor project, which allowed the City to use existing software components that ODOT had already procured.

- **Holistic** – It is important when advancing multiple technology and mobility projects, especially those integrating multiple modes, to use a holistic technology approach with common goals, providers, and solutions that can potentially contribute to multiple projects. The consistent coordination with the efforts and projects taking place elsewhere in the City, and through other funding sources, did result in successfully leveraging certain partnerships for the benefit of all stakeholders and projects. For example, the SMH leveraged both a grant from American Electric Power (AEP) for electric vehicle (EV) equipment.

- **Agile** – The tenets of Agile systems engineering – small, incremental ("thin slice") delivery and failing fast to allow for fast improvement – were crucial in managing the inherent uncertainties surrounding emerging technology. Applying this approach was key in managing risk and accommodating changes, while still completing documentation for user needs, system requirements and testing for all projects.

THE ROLE OF COMMUNICATIONS

Winning the SCC was a significant accomplishment for the City of Columbus and the region. The communications team became responsible for raising awareness as well as managing the public's expectations for the program. Collaboration from City partners, professional services agency and the City Communications Project Manager allowed for public emersion in the message of Smart Columbus in establishing a presence and engaging with end users.

As end-user needs were obtained and informed the Concept of Operations (ConOps) documents in the systems engineering process, the communication approach shifted from program-level to project-level. Each project's messaging, from fact sheets and end-user surveys to recruitment materials, was developed individually, based on the project's unique audience, stakeholders and engagement needs. Information about the entire program as well as each individual project was available on the Smart Columbus website. This helped the public and project-specific audiences understand how everything fit together.

Strategy and Considerations

The communications team built a communications plan that was aligned with the goals of each project. Below are factors that were considered when developing the appropriate communications plan for each project:

- **Captive versus public audiences** – The program communications goal was to get as close as possible to one-to-one communication with each end user. These targeted, "captive" end users were reached by working with organizations that had direct relationships with targeted end users. This allows the communications effort to be leaner than had input been solicited from more public audiences. For example, with the MAPCD project, there were a handful of organizations that worked with the cognitively impaired population directly. The communications team leveraged those relationships to recruit participants. Similarly, to determine the transportation

challenges of pregnant individuals, the team asked groups who worked with this target population to allow the team to conduct focus groups at one of their meetings.

- **Location** – Some of the projects were very localized, such as the Linden LEAP service; other projects were region-wide, such as the Pivot app, which included the entire COTA transit service area. Location is a factor when determining a communication plan because it allows use of specialized communication channels like a neighborhood newspaper or billboards. Understanding location also helps determine if there are any cross-promotion opportunities in an area via churches, community organizations, etc.

- **Current transportation habits** – It is helpful to understand the population's current transportation habits to determine which projects are the most relevant and beneficial to participate in. For example, if a person only uses the bus to get around, the CVE project is likely not of interest to them. In nearly every gathering during the ConOps development process, potential end users were asked for their input on their current travel habits and challenges. Secondary research that analyzed current transit ridership and safety trends in the project areas were also consulted to further identify challenges and project needs.

- **Level of behavior change** – If a project requires only minor changes in travel behavior, awareness-building communication activities alone may be sufficient to garner participation. If a project requires a significant level of behavior change, more experiential or low-risk trial communication activities and incentives may be needed to get people to participate. For example, if someone already uses multimodal mobility options or already rides the bus, getting them to use the Pivot app may be easier than for someone who drives a vehicle everywhere they go. Conversely, encouraging someone to install something on a vehicle requires significant effort for the participant. Thus, a financial incentive was added to increase participation.

- **Level of trust** – Understanding the audience's level of trust with the technology or organization leading the project is helpful to determine what potential barriers need to be overcome or mitigated to obtain participation. It is also helpful to identify people, groups, or organizations that have a high degree of trust in the community and work with them to share information with their constituency. The communications team included two Linden-based liaisons to provide credibility and transparency in this Columbus neighborhood, where several projects were deployed. Additionally, the City of Columbus Department of Neighborhoods, COTA, OSU and countless other project partners were eager to assist in communication efforts as needed. This extended the level of trust and outreach effort immeasurably.

- **Level of engagement in community** – Special considerations need to be made if trying to reach disenfranchised populations. Where traditional communication methods may not work, it is best to identify individuals and speak with them directly about how they get information and adapt tactics appropriately. The communications team worked closely with faith leaders, non-profit organizations and social service agencies. They provided guidance on how best to engage their constituents and allowed the communications team to convene end-user focus groups at their sites. They also shared project information and encouraged their customers to take surveys and attend public meetings.

- **User feedback** – Professionals drafted communications before sharing with end users or consultants who represented end users to ensure communications resonated with target audiences. Messaging was also tested via social media to determine which messages performed the best. Resources were reallocated into top-performing messaging.

- **Data analytics** – Data analytics plays a pivotal role in a digital campaign. The challenge of engaging a diverse population is understanding the variables and use cases that will drive adoption among a wide range of demographic or geographic groups. Geography and demographics play a large role in how people perceive and interact with their mobility. Understanding these differences in populations through analysis of publicly available data can help communication teams create targeted, impactful messages that resonate with target audiences and drive sustainable growth and adoption. Data analysis allows us to understand the human behind the project and what their

needs, wants, and motivations are. Dialing those factors into the messaging, allows the team to reach people with messaging that relates to them, and in turn, creates a connection between the message and the solution.

Tactics

Each project used the following tactics to the degree that was appropriate for the project. Overall, paid tactics were used at a higher rate to compensate for reduction in shared opportunities (namely community and in-person events) due to COVID-19.

- **Paid:** Paid media includes the development of content that the project paid to be distributed or promoted by someone else. Examples of paid media included:
  - Google ads, geo-fenced digital ads, social media ads/boosted/promoted posts
  - Ads in apps including apps like Waze, Pandora, Hulu or Spotify
  - Paid advertisements on local radio stations
  - Paid advertisements in This Week News and minority publications such as Columbus Minority Communicator and Columbus Black
  - Out-of-home ads like billboards, advertisements placed in movie theaters, or bench ads

- **Earned:** Earned media includes third-party content development and distribution. Examples included:
  - Print, online, TV or radio stories by local media outlets (via press release or media pitch)
  - Word-of-mouth endorsements from participants in-person
  - Letters to the editor

- **Owned:** Owned media includes creation of content by the City (the owner) and control of the platform on which the content is published. Examples included:
  - Project website
  - Project promotional video
  - Direct email
  - Newsletters
  - Experience Center exhibits and public information

- **Shared:** Shared media describes content created by the communications team that is distributed to an audience via a platform that someone else owns or controls. Examples of shared media leveraged included:
  - Social media (Facebook, Twitter, Instagram)
  - Community events and festivals (presentations, tabling)
  - Trusted messenger communication (word of mouth, email, text, newsletter, meeting, presentation, letter, blog, signage, handout).

Audiences

Audiences were different for each project. However, in general the communications team considered the needs of the following audiences when planning project-level communications:

- **End-users/participants** – People the project was designed to serve

- **Community advocates and** champions – Community leaders or members who were personally or professionally invested in the success of the projects, and were connected to different constituencies that could benefit from the projects

- **Partners** – Organizations that had a contracted role in the project/program

- **Shared learning community** – peer cities, smart city industry, professional organizations, and researchers

EXECUTING COMMUNICATIONS

There are a variety of skills and approaches that the communications team executed to effectively realize the strategy plans for each project. Each tool or method serves a different purpose and should be applied to meet the specific needs of each project to maximize resources (Table 1).

TABLE 1 Communications Tools and Approaches

Competency	Purpose	Project Example
Branding/Brand Awareness	Increases identifiability and allows for recognition of the program from a variety of sources. Users and stakeholders are more likely to engage with something that feels familiar to them.	The Linden LEAP shuttles were wrapped with custom Smart Columbus branding. Allowing the residents and other drivers to easily recognize the automated shuttles.
Copyrighting	Logos and other visuals need to be protected to allow for recourse if another entity uses improperly.	The Smart Columbus brand is copyrighted, protecting it so only authorized users can use it.
Crisis Communications	When an unexpected event occurs that deals with human safety, it is important to have quick and effective messaging to address the critical issue to the public. Poor management can lead to lost trust and low participation.	In February 2020, an onboard incident on a CEAV shuttle caused a passenger to be dislodged from her seat. The communications team was able to promptly put a statement together and address the concerns of the public in a timely manner.
Database Development & Visualization	Projects with a large collection of data benefit from a data repository and online visualization tool for users to access for quick analysis.	SCOS generated visuals that were used to analyze performance measures.
Digital Analysis and Audience Segmentation	Collects and presents data on the effectiveness of the communication tactics, gives insight as to what is and is not working.	EPM and MMTPA were able to use data from social media to isolate marketing techniques to target audiences.
End-User Engagement	Outreach needs to be done with the target audience to find what their needs are so that the project can address real issues and provide a positive impact for the users.	Smart Columbus attended community events in Linden to gain insight as to where the residents would find the SMH location to be most helpful to them.
Events	Brings attention to the project and gives opportunity to share messaging, recruit, and reach out to potential partners.	Smart Columbus would attend community events in Linden to talk with residents about the projects targeted for their neighborhood. Giving them an opportunity to ask questions and have a better understanding of the new technology.
Graphic Design	Good visuals will convey the message and give a call-to-action to the viewer.	PTA used flyers with appealing visuals and clear instructions to recruit pregnant individuals to enroll
Grassroots Engagement	Vital to recruiting from an opportunity neighborhood. Grassroots engagement creates a personal connection which builds trust and relationships with those running the project and the target audience.	Volunteers went door-to-door to the houses along the Linden LEAP route to explain the technology and what residents can expect from the project.
Local Public Relations	Projects that depend on local adoption depend on positive media relations with local news sources. These groups have regular and dependable reach to the project's target audience.	The launch of the Linden LEAP route coincided with a press release event with local media news outlets.

Competency	Purpose	Project Example
National Public Relations	Large projects that receive national attention, especially with federal funding, need to have the media relations supervised to ensure an accurate message is being broadcasted.	The Linden LEAP attracted attention nationally as it was the first automated shuttle to be deployed in a residential area.
Paid Digital Management/Optimization	Fee based digital marketing provides a wider reach to target audiences, it is more effective for fresh recruitments since the user would not need to be previously aware of the program to be exposed to the marketing.	EPM and MMTPA used paid social media ads to reach out to a wider audience of potential app users.
Public Speaking	Face-to-face communications gives a more personal approach and helps the project better connect with participants. Association with a person makes a participant feel more comfortable with the program and more likely to enroll.	Representatives from Smart Columbus attended CelebrateOne meetings to explain the function and uses of PTA.
Research Design and Analysis	Early data collection and analysis is needed for user needs and other systems requirements.	OSU conducted a trade study to determine the best app for the MAPCD project.
Smart Columbus Experience Center (public education and meeting space)	Having a physical space where people can see presentations and ask questions creates an open and inviting environment that increases participation.	The Experience Center had the same kiosk as those used in SMH in its lobby so visitors can ask questions and try it for themselves.
Smart Columbus Live (awareness building presentation)	In-person presentations that give a personal touch and opportunity for audience Q&A.	Attendees were surveyed and found that interest in electric vehicles increased from 48% to 73% after attending the event.
Social Media Management	Provides opportunity for outreach and to address questions and concerns that the public posts to the program's social media pages.	EPM used social media to promote adoption of the ParkColumbus app.
Stakeholder Engagement	Continuing to capture stakeholder attention allows for those that have a vested interest to continue to provide input to the project. This is especially important if the long-term owner of the project is not the entity managing the project.	COTA was an involved stakeholder in many projects, including: CEAV, CVE, MAPCD, MMTPA, and SMH.
Strategy/Planning	Preparing ahead of time on methods of engagement allows for less waste of time and resources.	Smart Columbus used the lessons learned from the Tampa connected vehicle pilot to maximize driver recruitment resources.
Survey Development	Information gathering is important when collecting user needs and performance measures.	MMTPA conducted surveys to find travelers bus habits, this allowed for a better user experience in trip planning.
Tool Integration/Automation	Increases efficiency and accuracy while decreasing the potential amount of human error.	Performance metrics data was automatically uploaded to the SCOS for analysis.

Competency	Purpose	Project Example
Vendor Management	Overseeing vendors ensures that goods and services are being delivered accurately and timely, this can greatly impact program delivery if something is late or incorrect.	CVE required frequent communication with vendors on the status of the equipment, especially after the onset of COVID-19 when overseas manufacturing and shipping were impacted.
Video Capturing and Editing	Videos are more engaging and provide more information in a quick and captivating way than static messages.	CVE used training videos to ensure a consistent and accurate instructions went out to all participants.
Website Development	Visually appealing and easy to navigate website allows for users to get the information they are looking for, if the user finds the website too cumbersome, they may become frustrated and decline to participate.	The CVE participant recruitment website was designed for ease of use to encourage potential drivers to complete the questionnaires and surveys.

Source: City of Columbus

Co-Creation is a critical element of success. Smart Columbus used local resources to connect with the community and drive execution. There are three key examples:

2. Linden Liaisons: Given the number of projects deployed in the Linden neighborhood, and working in a historically disenfranchised community, the communications team decided it was important to hire two people from the Linden community to serve as community liaisons assigned to support end-user engagement activities. The Linden Liaisons were responsible for sharing updates about the projects in community meetings, distributing materials to residents, having one-on-one conversations with residents to better understand barriers to adoption, and recruiting residents. They supported five projects that had footprints in the Linden area: PTA, CEAV, CVE, SMH, and MMTPA. The communications team recommends hiring community liaisons to support outreach and engagement work. Valuable insights were gleaned by their serving as eyes and ears in the community. Often community outreach is done by volunteers who have a high level of recognition and pre-existing relationships in the community. Paying these individuals for this important work allows them to dedicate strategic time and effort, hones or expands their skill set, and helps build trust in the community by demonstrating that the City values the community's input.

1. New Salem Community of Caring Development Foundation: The Community of Caring Development Foundation is New Salem Baptist Church's non-profit, community development corporation (CDC), operating as the church's community and economic arm. The CDC focuses on social determinants of health such as community wealth building, supporting education, affordable housing and individual health and wellness in the Linden area. The organization's mission is to create a connected community, and for more than 20 years it has been committed to investing in the lives of individuals and families, as well as small businesses and community-based organizations in the Linden community. The CDC consulted on five projects that had footprints in the Linden area: PTA, CEAV, CVE, SMH, and MMTPA. The CDC's participation provided access to the community through a trusted organization. Their insights were invaluable to help identify barriers to participation, develop messaging and strategy, and assist in outreach through community programming.

3. Working Groups: The Cooperative Agreement required the recipient to assemble two Technical Working Group (TWG)s related to electrification and data. The Data TWG was especially critical in delivering some aspects of the USDOT cooperative agreement. The Data TWG was used to facilitate communications, knowledge sharing, identification of project risks and use of best practices to fulfill requirements around replicability, openness, evaluation and sharing of open, controlled

access, real time and archival data (specifically, to enable review and feedback on project deliverables). All working groups helped the PMO to generate and maintain community involvement through additional working groups with the purpose of engaging with the City's diverse stakeholders to serve as advisors on goals, metrics, budget, policy, operations, end-user needs, deployment strategies, needed adjustments and other project-specific decisions. The structure of these additional working groups began as a way to jump-start the project systems engineering process, create an intentional process for community engagement, and bring together a subset of the stakeholders to help diversify how the project teams approached solving city challenges.

RESULTS, MEASURING EQUITY IMPROVEMENTS, AND IMPORTANCE OF COMMUNICATION AND COLLABORATION

Results

While all outcomes were measured, providing improved access to transportation options for Columbus residents was of vital importance to the Smart Columbus Program and was a goal from the time of the application. The program sought to increase underserved communities' access to a wide variety of services through transportation solutions focused on improved access to places of employment, education, health care, and other services, and to address barriers that travelers face with existing transportation systems. All five objectives for this intended outcome were achieved with full or partial success, with measurable outcomes including:

- Survey respondents reported a significant increase in access to health care (baseline: 4.33, treatment: 3.27 on a 7-point scale where lower is easier) and entertainment (baseline 3.36, treatment: 2.63) after implementation of the Pivot app, and a marginal increase in ease of getting to work (baseline: 3.9, treatment: 2.93)

- MAPCD participants achieved a feeling improved independence as the WayFinder app gave them the support needed to travel on fixed route bus service alone, without having to rely on a ride from caregivers, friends, or family.

- The number of participants in the PTA study who did not take NEMT trips decreased from 44% in the usual care group, to 19% of participants in the intervention group.

- The CEAV shuttles helped mitigate first/last mile transportation obstacles by bringing food pantry boxes to the Rosewind Community Center, making it easier for many food-insecure residents to access fresh foods. This was especially important during the pandemic when food pantry demand increased and there was hesitancy or inability to ride public transportation or get rides from friends and family without risking COVID-19 exposure.

The following communications metrics demonstrates the successful efforts in implementing the communications strategies for the listed projects:

- CVE
    - Recruited the largest number of participants from the Linden area, accounting for 21% of all participants, goal was achieved
    - 26% conversion rate from prequalification (1,190) to installation (311)
    - 59% of questionnaire completions were qualified for program (702/1190), shows high success in targeting eligible audience

- MMTPA
    - Website analytics shows a total of 793 conversions; engagement rate 16.2%
    - Facebook and Instagram: 16,546 clicks, 574 post reactions; 199 conversations; 68 post shares
    - Google App Campaigns: 97,196 impressions; 2,165 clicks; 69 conversions

- PTA media buy reached estimated 300,000 impressions or interactions

- SMH Facebook and Google Display: 16,000 post engagements; 2,000 clicks; 170 reactions; 45 shares

- EPM
    - Columbus Underground and CD 92.9 ads estimate a total of 7,024 new ParkColumbus user registrations
    - NextDoor click-through rate 0.17% compared to 0.15% for region during this time period

- 171 total contest entries for Facebook, Instagram, and Twitter

- ParkMobile email blast 37% open rate; 1.5% click-through rate

Measuring Equity Impacts

Outside the scope of the six outcomes defined in the Performance Measurement Results, OSU also evaluated the economic and accessibility impacts of the program:

- The economic analysis calculated a short-term impact of $147.86 million in gross metropolitan product (GMP), $51.05 million from direct investments by the program, and $96.82 million in indirect effects, through impacts on the supply chain and increased household spending. Furthermore, investments by the program are likely to generate an increase of 4,220 jobs, with approximately 719 jobs generated as a direct effect of the expenditure from the Smart Columbus Program-related staffing, with the remaining 3,501 attributable to the indirect effect on the affected sectors through the supply chain. The long-term projected impacts have more uncertainty, due to the difficulty in projecting future effects of the program. However, assuming the successful deployment of the Smart Columbus Program projects, utilization of the services is likely to generate a $671.28 million or 0.5% increase in GMP, and 7,039 jobs (an employment increase of 0.3%). Overall, the multiplier of the Smart Columbus Program investment was found to range between 1.71 and 2.09, indicating that each dollar invested in the Smart Columbus Program is associated with an increase of between $1.71 and $2.09 in value added to the local economy.

- The accessibility analysis evaluated the improvement in potential mobility provided by the application of Smart Columbus projects to access employment and community services. It utilized the Linden Transit Center as a representative starting location, and examined public transit routes and schedules, sidewalk networks, the location and availability of docked and dockless micromobility options, and other information to compute the area that could be reached within a set travel time (30 minutes)

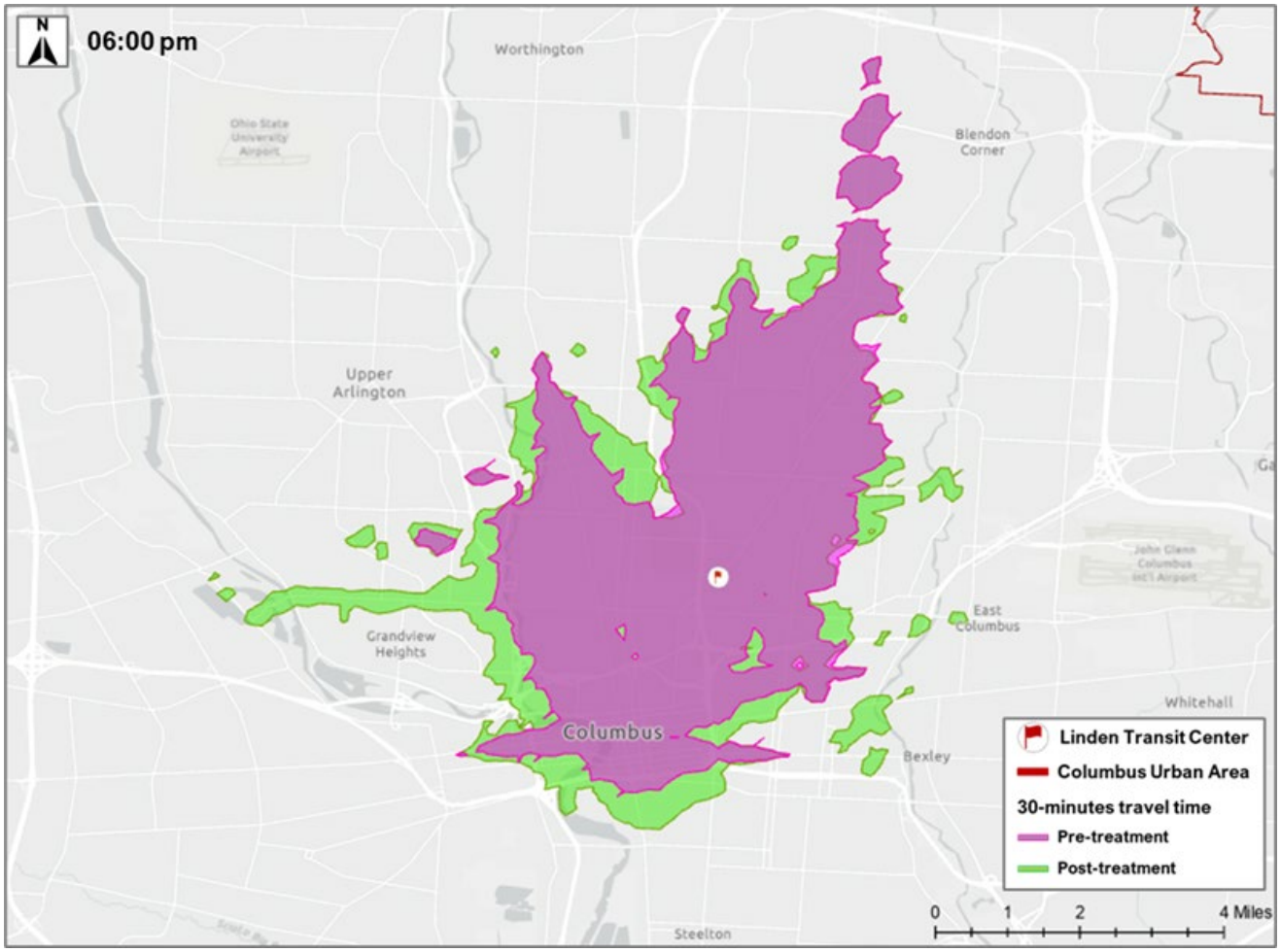

FIGURE 2: The Ohio State University accessibility analysis. Source: OSU

both with and without the Smart Columbus project improvements. The analysis then computed the number of job and health care locations that could be reached within the set travel time with and without the improvements.

  - The accessibility area (defined as the area a traveler could reach within 30 minutes) expanded regardless of the time of day assessed (9 a.m., 1 p.m. or 6 p.m.) (Figure 2).
  - As a result of the expansion, travelers would be able to reach at least 20,000 additional jobs and 3,000 additional health care services than they would using the trip planning tools that existed prior to the introduction of the Smart Columbus projects. The increase in accessibility was even greater for certain classes of jobs and services and at certain times of day.

- These accessibility improvements can provide benefits to those living close to or interacting with the SMHs. Specifically, OSU's housing assessment analyzed SMH-adjacent neighborhoods to determine if they displayed new housing market activity relative to similar neighborhoods. The housing analysis results provide context for how neighborhoods may evolve in the future.

- A sizeable effect of SMHs on short-run market activity was found that implies a 33.5% increase in sales likelihood for residential parcels.

Impact of Early and Consistent Communication and Collaboration

For iterative technology projects, resident engagement must be a continuous, two-way conversation. The City found it critical to engage early and often with all program stakeholders. Communications should start even before funding is identified because isolating the problems to be solved and identifying the best solutions may take time.

The City found it important to align with stakeholders on goals and project locations early in the process, as user needs may grow or change from what is first assumed. To the extent feasible, stakeholders should remain engaged as the project continues development so that changing needs can potentially be incorporated. Be adaptable to changes not just during the systems engineering process, but throughout design, construction, and deployment as well, to accommodate the pace of emerging technologies.

When communicating specific projects, the City found it best to use an integrated set of paid, earned, owned and shared communications strategies that leveraged innovative, data-driven approaches. Communication can lessen distrust of technology and improve adoption, particularly where outreach results in co-creation and a level of mutual comfort with the audience/neighborhoods being reached. Recruiting Beta testers during app development helps to capture feedback on the User Interface and User Experience. This is valuable information to help shape the look and feel of the app while addressing user needs.

Communication within the team was also essential to strong external communications. Communicators must work closely with technical leads to understand project schedules to ensure the key pieces of engagement occur at the right time.

LESSONS LEARNED AND CONCLUSIONS

Lessons Learned

Delivering a diverse portfolio of projects over five years presents communication challenges. Below are recommendations based on that experience:

- Include a communications and engagement professional who can provide oversight and build an appropriate team to meet the communication and engagement goals throughout the program.

- Identify people or organizations in the community who are already doing work that aligns with the project and contract with them for their expertise and insights.
  - Leveraging these trusted messengers was a key tactic. Local and federal governments are not always the most trusted messenger for certain stakeholders, and therefore alternatives should be identified and used to help overcome these challenges.

- Ensure the communications team is closely embedded with the technical team to confirm communication and end-user engagement milestones are accounted for in the overall project plan and schedule.

- Engage end users throughout the project development and find opportunities to co-create with residents.

- When working with disenfranchised populations, it is important to meet people where they are. That may mean going to a community dinner or to the hair salon, or communicating through a church, organization or individual within the community. Find ways to coordinate with other things happening in the community to prevent meeting and survey fatigue from residents. It is also important to ensure the proper supports are in place to help get representational attendance at meetings; for example, providing food, childcare, or bi-lingual and hard of hearing support.

- The engagement of these communities was extremely important in building awareness and trust with the community long before the projects launched and was equally as important as the engineering aspects of the projects.

- Plan regular communication touchpoints with key stakeholders to better manage project expectations as projects evolve and maintain engagement throughout the project lifecycle. People liked to see the impact of their time and efforts. Some tactics used included:
    - For the working groups, a segment report-out process was used to share outcomes with members and enabled a pride in their work and understanding of how their efforts were implemented. In addition, any way in which volunteers wanted to contribute was welcomed, although classified appropriately.
    - Reporting back to the community to explain how their input was used was critical. This was done through e-newsletter articles, presentations and a final report to the community.
    - Because volunteers can burn out, causing participation to wane, the working groups used smaller segments with defined outcomes and schedules, which created a path for participants to engage in alignment with their interest, expertise and schedules. This also led to other multiple opportunities for leadership within the community, helping to reduce drop-off in participation (Figure 3).

- Use a multichannel, integrated communication approach, when appropriate. This included not only residents, but partners as well.

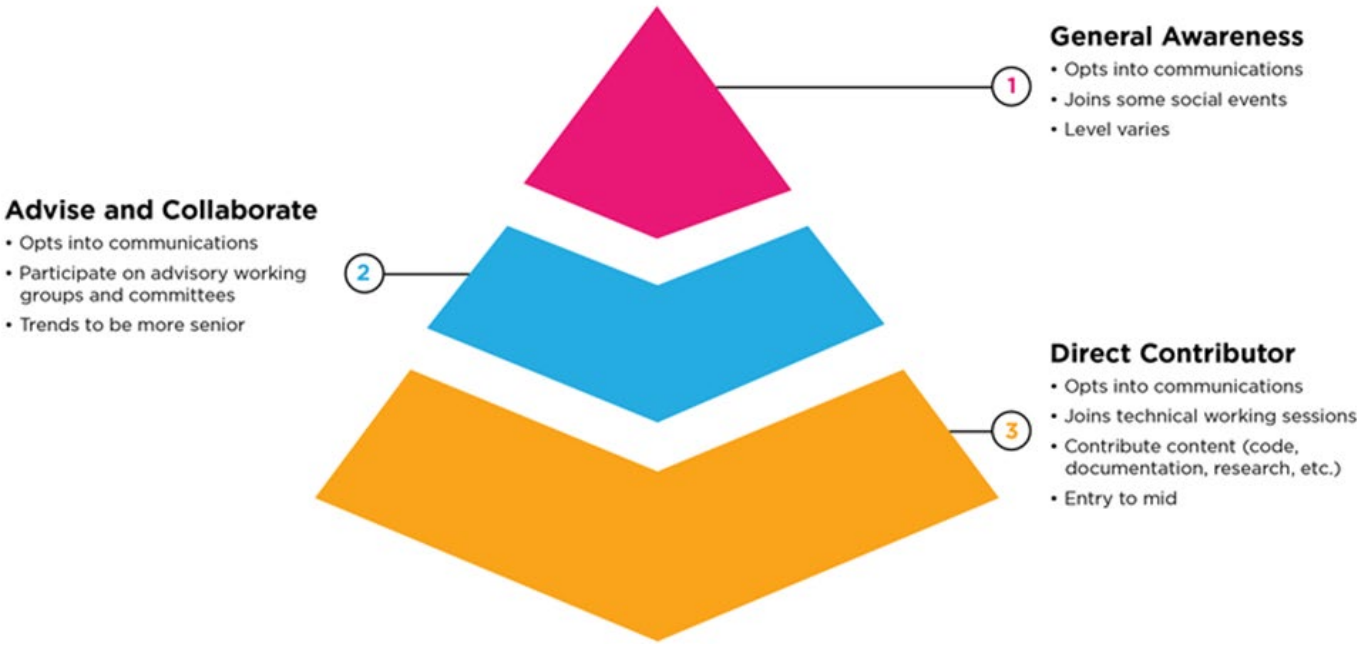

FIGURE 3: Data technical working group levels of engagement.
Source: City of Columbus

- Communications to both residents and partners require planning and resources and are equally critical to success. The resource allocation is distinctly separate because it requires the communications teams to talk about projects from two very different angles.

- Coordination is required to get stakeholders to share your message and content, but the impact is significant compared with other communication tactics.

- Community issues not directly related to the project will arise at stakeholder and outreach meetings. Build mechanisms to ensure those issues are shared with the appropriate City contacts.

- Leverage private sector assets, when possible.

Conclusions

Communications was a key activity throughout the Cooperative Agreement – From the time of award to post-launch of most projects, the benefits of communication to the program cannot be understated:

- It was originally envisioned that stakeholder engagement would provide the most value as the projects developed concept and requirements. However, the PMO saw value in continuing end-user engagement as the projects continued through development, testing and launch. Participant recruitment is obviously important, especially for projects such as CVE, MAPCD and PTA, where informed consent is needed, surveys are expected, and frequent interaction is required. It was also important, however, for other projects to maintain communication with the community to educate and prepare them for the technology (such as for SMH and CEAV) and could have been used even more for projects such as MMTPA, where beta testers provided direct feedback to the development team on the performance and usability of the Pivot app.

- Coordination and communication at the state and regional level with funding partners is also critical. This coordination and communication helped the PMO to efficiently leverage assets, workforce, and knowledge while achieving interoperability and awareness for many of the projects. Forward focused projects may also require regulatory/policy changes that can only be driven at the state level. Good examples of this coordination include:

    - The coordination between the City and ODOT to implement certain CVE system components including position correction and the security credential management system (SCMS).
    - The first CEAV deployment with May Mobility, which was co-led by ODOT, The Columbus Partnership and the City. ODOT led the procurement effort, scope development, and contract conditions, while the City managed the day-to-day operations after the vendor was selected.
    - For the second CEAV deployment, the City used the lessons learned from the first deployment to create a more robust RFP and requirements, while ODOT remained as an engaged stakeholder, providing permitting and regulation for the vehicle's operation in Linden.

Ultimately the City used the Smart Columbus Program as a springboard to innovation. More importantly, the program empowered residents to live their best lives, as demonstrated by several important and quantifiable results. A few of the many great examples are the MAPCD project empowering individuals to travel independently for the first time, making mobility options more accessible for the Linden community through the construction of the SMHs in the neighborhood, enabling to reserve and pay for parking in advance (and check the likelihood of finding an on-street space) through the ParkColumbus app, and the CVE project training a local automotive shop on the installation, use and operation of connected vehicle technology. These examples are among the many that are were identified during the demonstration, and show the community impact of the program, both big and small.

Projects from this portfolio will be sustained to continue to serve the mobility needs of Columbus residents, and the partnerships and project management methodologies honed through the program will benefit the community for years to come. Through the implementation of the SCC, the projects have created short- and long-term impacts for the Columbus community and created a replicable playbook that other cities may build upon to have similar effects across the nation. The Smart Columbus Program has also added to the knowledge base for smart cities projects, advancing

the development of multimodal and MAPCD-type projects, spurring research into the benefits of prenatal trip assistance, and helping advance vehicle automation and connected vehicle technology.

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