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Improving transit in small cities through collaborative and data-driven scenario planning

Robert Goodspeed [a,*], Kidus Admassu [a], Vahid Bahrami [b], Tierra Bills [c], John Egelhaaf [d], Kim Gallagher [d], Jerome Lynch [e], Neda Masoud [a], Todd Shurn [f], Peng Sun [g], Yiyang Wang [a], Curt Wolf [a]

[a] University of Michigan, Ann Arbor, MI 48109, USA
[b] Wayne State University, Detroit, MI 48202, USA
[c] University of California Los Angeles, Los Angeles, CA 90095, USA
[d] Southwest Michigan Planning Commission, Benton Harbor, MI 49022, USA
[e] Duke University, Durham, NC 27708, USA
[f] Howard University, Washington, DC 20059, USA
[g] University of Central Florida, Orlando, FL 32816, USA

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ABSTRACT

Small communities lack effective transit planning methods that integrate diverse forms of knowledge, foster collaboration, and envision better transit futures. To address this need, this paper presents a case study of a project conducted in Benton Harbor, Michigan. The case study demonstrates a collaborative and data-driven scenario planning process conducted for a small region, and evaluates it through a mixed-methods research design. Through the use of quantitative normative service scenarios and qualitative exploratory scenarios, the project generated financially and operationally feasible proposals that community leaders can implement in the future, and also fostered constructive dialogue among transit stakeholders. Survey data show that participants experienced high levels of learning, engaged in quality deliberation, and are generally optimistic about the potential for improved transit. The project's approach can be replicated elsewhere through the use of five essential elements: a steering committee, stakeholder analysis, a series of engagement workshops, normative and exploratory scenarios, and interaction between data and modeling. Collaborative planning with scenarios can help the transportation field address the need to foster collaboration and epistemic inclusion in a changing world.

1. Introduction

Millions of people rely on public transportation for everyday travel needs like getting to medical appointments, grocery stores, schools, or places of employment. In addition, small transit agencies that serve many of these trips face a dynamic environment with ongoing shifts in demographics, land use, and available technologies in the communities they serve (Litman, 2017; Nigro et al. 2019).[1] Differences in transit agency capacity and rider options compound the challenges for smaller communities: in large cities, transit agencies have greater capacity to engage in service planning and pursue competitive grants, and riders in larger markets often benefit from taxis or ridesourcing that are not always available in smaller communities.

Consequently, small transit agencies have distinct service planning needs that are not well met by existing approaches developed for larger places. Travel models often used to determine transit service demand for larger regions are ill-suited for small communities given their use of relatively large travel analysis zones, which do not address granular planning questions about specific routing and destinations. The existing transit planning literature often focuses on highly abstract, technical methods that neglect local knowledge (e.g., Ceder 2015; Vuchic 2005). Popular works on transit provide advice on service frequency, cost, and bus stop design, but not on route planning methods (Higashide 2019). In light of the modest levels of funding available to them, many small transit agencies engage in collaboration with public- and private-sector stakeholders to obtain additional funding, work on outreach and

* Corresponding author at: 2000 Bonisteel Blvd, Ann Arbor, MI, 48109, USA.
E-mail address: rgoodspe@umich.edu (R. Goodspeed).

[1] We follow Blume et al. (2021) and define a small agency as one that provides fewer than 10 million trips per year.

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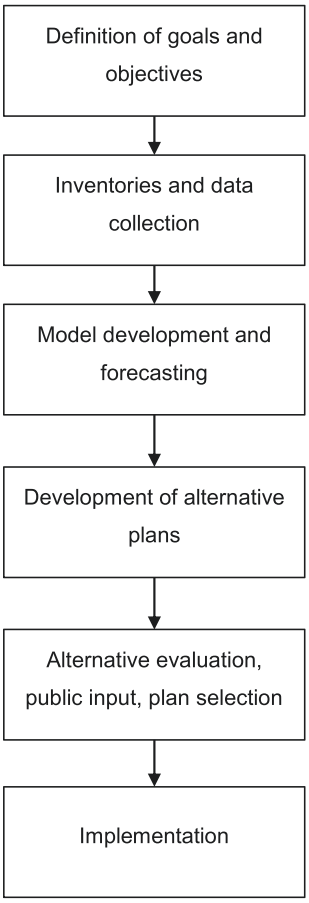

Fig. 1. Our project differs from the traditional transportation planning process, shown here, which involves a linear process of technical analysis with only a minimal role for public participation. Based on Figures 10.1 and 10.2, pp. 480 and 481 in Vuchic (2005).

education, and improve bus stops (Blume et al. 2021).

A challenge facing all transit planning practitioners concerns how to overcome barriers created by existing tools and methods. The dominant role of four-step travel models within transportation planning has led to the concern that they privilege certain forms of technical knowledge over rider perspectives (Nostikasari and Casey 2020). In small regions, riders and system operators sometimes possess extensive community insights that are valuable for route planning. Nostikasari (2015) argued that the typical representations used within these models neglect important issues in marginalized communities, such as concerns about public safety and incomplete sidewalk networks, and include the assumption that wealthier communities travel more, which results in self-fulfilling prophecies through infrastructure decisions privileging certain travelers and places. Pursuing methods that can integrate diverse knowledge and perspectives is seen as essential for achieving transportation justice, through meaningful involvement and epistemic inclusion (Karner et al. 2020). More pragmatically, collaboration offers the potential to build data literacy in communities where transit analysis may not occur frequently.

Philosophically, underpinning many of these challenges is a need to create new, more collaborative approaches to transit planning that would be applicable not only to small agencies but also to the field as a whole. Willson (2001) and Willson et al. (2003) outlined how traditional transportation planning is underpinned by a philosophy of instrumental rationality and objectivity that presumes the existence of clearly defined societal goals and outlines the planner's role as primarily to implement neutral, technical analysis without much involvement from affected communities. Similarly, Innes and Gruber (2005) observed conflicts within a metropolitan planning organization (MPO) between the *collaborative* planning style and other styles they described as *technical/bureaucratic*, *political influence*, and *social movement*. An empirical analysis of five urban transport cases documented the elements needed for collaboration success are management of a multi-actor network, a high diversity of actors, and knowledge integration methods (Walter and Scholz, 2007).

The historical emphasis on technical approaches dominated by instrumental rationality is exemplified by the standard process described in classic works such as Vuchic's (2005) *Urban Transit: Operations, Planning and Economics, visually summarized in* Fig. 1. In our view, local transit planning features many of the challenges Willson (2001) outlined for those methods: there is no consensus on a single goal, available models do not align with relevant topics and geographies, and the conventional approach neglects the importance of stakeholder engagement to overcome barriers to service-improving changes. In place of traditional paradigms, Willson (2001) proposed the adoption of Habermas' concept of communicative rationality as the basis for transportation planning, describing it as a dialogue-centered process that integrates consideration of social and technical perspectives, and calling on the transportation field to experiment with alternatives and "build capacity for new approaches" (p. 27). Our project takes inspiration from the literature on collaborative planning and seeks to create a process centered on dialog and communicative rationality (for more on collaborative planning, see Innes and Booher 2018; Forester 1989; and Healey 1997).

Although there is limited transport planning literature which makes explicit reference to the concept of communicative rationality and the broader theoretical concept of collaborative planning, many projects have made use of collaborative approaches. Therefore, this work also contributes to the literature on topics such as the inclusion of stakeholders (e.g., Ward, 2001), use of information-rich workshops (Stewart, 2017), and emphasis on participation (Booth and Richardson, 2001) within transportation planning.

In parallel with the interest in collaborative transportation planning, there has been growing interest in the adoption of scenario planning methods in the transportation field (Lyons and Marsden, 2021). Involving the creation of multiple plausible futures, scenario planning has been viewed as a useful method for integrating values and technical analysis, and for fostering collaboration and learning. However, the development of scenario methods for transportation has been based in larger regions who generally have greater resources to engage in methodological innovation. The Federal Highway Administration's influential guidebooks for scenario planning have promoted the method but are more geared toward larger regions seeking to use scenarios to inform performance-based planning and programming activities within MPOs (Federal Highway Administration, 2011; Twaddell et al. 2016). The best-known applications of scenario planning are often large projects conducted at the regional scale (Goodspeed 2020; Sherman and Chakraborty 2022; Zegras et al. 2004). Similarly, although MPOs (Deyle and Wiedenman 2014) and statewide departments of transportation (DOTs) (Taylor and Schweitzer 2005) have increasingly conducted collaborative planning with some documented success, case studies and models suited for small and rural communities are lacking.

Because of these overlapping needs, this article presents a case study demonstrating, and evaluating through a mixed-methods research design, a collaborative and data-driven scenario planning process conducted for a small region. In this process, we sought to achieve several goals:

1. Implement a collaborative approach to transit planning appropriate to a small community setting,
2. Foster stakeholder engagement in all aspects of the project, including in the data and modeling tools used, and

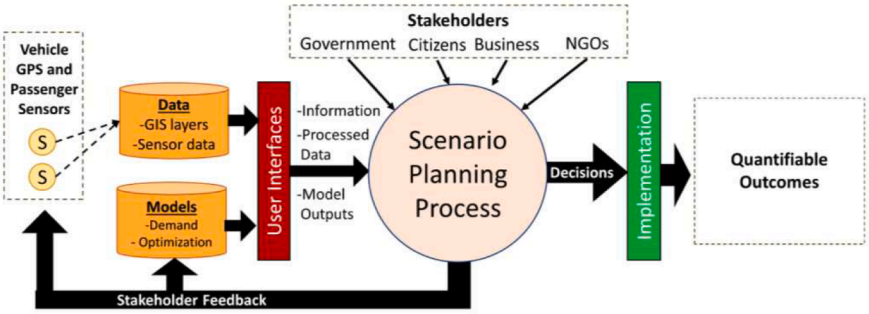

Fig. 2. The scenario planning process was envisioned as the primary link between various smart mobility data collection activities and changes that would improve mobility-related outcomes in the community. *Notes.* GIS = geographic information system, GPS = global positioning system, NGO = non-governmental organization.

3. Demonstrate how normative and exploratory scenarios can be used to highlight alternatives and foster discussion of strategic options for a small transit agency.

The goal of this paper is to describe how we used a scenario process to integrate knowledge and perspectives from different stakeholders, as well as how to integrate data collection and modeling into the process. However, we do not present the full technical details of the models, which are documented elsewhere. We then sought to characterize how successful the process was according to different measures: survey data collected at the three main workshops, qualitative feedback from participants, and reflections from the project participants. To do this, the paper's methods encompass both the scenario process and the survey evaluation approach. The results are both the products of the scenario process—a description of the ideas, consensus, and ultimately the scenarios produced—as well as the results from the evaluation survey.

To present the case, we first provide a description of the case context and project origins. Next, in the methods section, we outline the planning, data and modeling, and evaluation processes. The results section describes how the planning process unfolded, presents the resulting scenarios created, and reports the results from the evaluation survey conducted at major workshops. In the discussion section we reflect on the evidence of project success, expand on how our method could be translated into other contexts, and discuss other lessons learned.

2. Case introduction

The City of Benton Harbor (pop. 10,036) is located in southwest Michigan and is distributed over a 4.7-square-mile area near the shores of Lake Michigan. It is located in Berrien County and is located adjacent to a twin city of St. Joseph, Michigan (pop. 7,745). Benton Harbor is one of the poorest communities in Michigan with a per capita income of $15,629 (with 44.9 % of the population living below the poverty line); this is in stark contrast to St. Joseph, which has a per capita income of $43,250 (U.S. Census Bureau, 2021a, U.S. Census Bureau, 2021b) . These cities also exhibit a pattern of racial segregation common in many American cities, with Benton Harbor comprising 85 % African-American and St. Joseph 86 % White residents. At one time, Benton Harbor was an affluent city with manufacturing jobs available for city residents, and remains the world headquarters for the Whirlpool Corporation. However, the relocation of these jobs over the years has eroded economic opportunity in the city, resulting in employment challenges, population loss, decline in city financial resources, and under-performing schools. The financial situation in Benton Harbor was so dire that the State of Michigan placed the city under financial management in 2010; the city exited state oversight in 2016, giving it a clean but limited financial position for continued service provision.

While many jobs and job training resources exist outside of Benton Harbor, they can be difficult for segments of the population to access because 29 ∓ 6 % of all households have no vehicles available to them (U.S. Census, 2021c). This requires much of the community to be reliant on the public transit system that is managed by the Twin Cities Area Transportation Authority (TCATA). TCATA runs two schedule-based bus routes and an on-demand shuttle service (Dial-a-Ride). TCATA's transit services serve the City of Benton Harbor and several surrounding jurisdictions, including Benton Township, the City of St. Joseph, and St. Joseph Township. In 2021, the organization provided 43,725 trips on the fixed routes, and 61,983 trips through the demand-response Dial-a-Ride service, which is also open to the public. As a small transit agency, it lacks internal planning capacity, relying primarily on assistance from a tri-county regional planning agency, the Southwest Michigan Planning Commission (SWMPC) for planning services. The two fixed routes, a Red Route and Blue Route, had not changed in many years, and agency and community leaders were finding that the routes were no longer serving the current mobility needs of the community.

As a result, Benton Harbor community leaders began discussing smart mobility research with University of Michigan (U-M) faculty. These conversations were initially launched by an individual, Benton Harbor native and U-M engineering alum Todd Shurn. Further discussions occurred at a workshop held in Benton Harbor in October 2016 facilitated by U-M researchers emphasized the importance of mobility as a local priority. This conversation led to a group of five key community stakeholders: TCATA, Kinexus (an employment and workforce development agency), Southwest Michigan Planning Commission (a regional planning agency that serves as the MPO), and the City of Benton Harbor. Shurn became one of two project consultants involved in the project, which also involved U-M faculty members with backgrounds in travel modeling, travel behavior surveying, infrastructure sensing, and urban planning. In 2018, this group received a 4-year, $1.4 million grant from the National Science Foundation's Smart and Connected Communities Program, to conduct the project from 2018-2022.

3. Methodology

The project sought close integration between data and modeling processes and stakeholder input. This is conveyed in Fig. 2, created as part of the proposal writing process, which shows the team's consensus that the scenario planning process should serve to integrate the data collected and the stakeholder input, and to provide recommendations about implementation decisions. However, the specific steps within the scenario process were undefined at this stage. After launching the project, the authors defined the scenario planning process in greater detail, as shown in Fig. 2. The overall project governance involved a monthly steering meeting with all academic participants, project consultants, and representatives from the City of Benton Harbor, Kinexus, the Southwest Michigan Planning Commission (SWMPC), and TCATA. Henceforth, we refer to this group as the *project team* because it provided coordination and oversight to all aspects of the project. These meetings

Table 1
Overview of scenario process. *Notes.* [a]Participation typically included at least one representative from each of the four key stakeholders: City of Benton Harbor, Kinexus, TCATA, and SWMPC. [b]The distribution list for the second workshop was 58. Four joined the live Zoom and responded to the survey, and 14 others reviewed the materials and completed the survey. [c]Meetings varied somewhat in size, but in addition to stakeholder participants these meetings typically included two consultants, the five participating faculty, along with participating student research assistants from each of the five labs. [d]One faculty member with two research assistants conducted the interviews and prepared a summary memo shared with the entire team.

	Steering Committee	Stakeholder Assessment	Workshop 1: Problem Analysis and Principles	Workshop 2: Project Update and Scoping	Scenario Design Meeting	Workshop 3: Scenario Discussion and Refinement
Date	Jan. 2019 - Aug. 2022	January-May 2019	Nov. 22, 2019	June 4, 2020	Aug. 17, 2021	May 12, 2022
Format	Hybrid and virtual (Zoom)	Remote and in-person interviews	In-person	Virtual (Zoom)	Virtual (Zoom)	Hybrid event (in-person and Zoom)
Purpose	Provide ongoing project oversight	Identify stakeholders, collect local knowledge	Share preliminary data and project information, identify key principles and priorities	Share project updates, scope scenarios, seek feedback via poll	Create draft service scenarios from local knowledge and modeling	Present final scenarios and scenario metrics, discuss refinements and implementation
Stakeholder Participants	4-9[a]	17	27	18[b]	3	18
Project Team	10-20[c]	3[d]	9	10	7	14

involved technical updates and discussion, consultation about the design and implementation of the scenario process, and ongoing discussion about changes to the local context.

4. Scenario planning process

The primary elements to the stakeholder process are shown in Table 1. After launching the project, we conducted a stakeholder assessment using the methodology described in Susskind and Thomas-Larmer (1999). Under this method, a snowball sample of stakeholders is selected for interviews to fulfill two purposes: to collect information about their knowledge and perspectives, and to generate a list of stakeholders who will be invited to participate in the collaborative process. The interviews were conducted by phone, Zoom, and in person, and used a semi-structured protocol which invited interviewees to share insights about community mobility needs and their perspectives on TCATA and other available transportation services. The interviews started with the participating stakeholders (SWMPC, TCATA, Kinexus, and the City of Benton Harbor) and continued to include the Benton Harbor community development director, members of the TCATA Board, a member of the Benton Harbor Downtown Development Authority, two staff members from the Michigan Department of Transportation (MDOT) Office of Passenger Transportation, an owner of a local manufacturing firm, two local civic leaders, two employees of social service agencies, a community college staffer who managed a program with many students from Benton Harbor, and the Chief Executive Officer of the local Boys & Girls Club. A number of additional individuals did not respond to our interview invitations. The interviewees were invited to participate in the process, and the interviews resulted in knowledge that informed the project, such as a list of key destinations, understanding of political dynamics, and community perceptions and experiences with TCATA. Interviews were recorded, transcribed, and summarized in a synthesis memo shared with the team.

After conducting the stakeholder assessment, we developed a plan for the remaining scenario process in consultation with the steering committee, finalizing the plan in October 2019. We revised the process again in March 2021, after the first two workshops had been held, to reflect adjustments made for the pandemic, as well as the team's decisions about the study area, types of scenarios, and evaluation metrics.

The remaining scenario process involved three workshops and a scenario design event. As a result of the COVID-19 pandemic, the second workshop and scenario design events were held virtually via Zoom, and the final workshop was held as a hybrid event. In addition, the team decided to create the scenarios with a smaller group of stakeholders rather than during a large in-person workshop as originally proposed, in light of the detailed feedback which had been collected through prior engagements. Summaries of notes and feedback obtained from each event were developed and circulated among the project team.

5. Data sources and modeling

The project incorporated a variety of quantitative and qualitative data, as well as three specific models. The primary data sources included:

1. **Qualitative insights** collected from the interviews and workshops.
2. **Local knowledge** about particular corridors, destinations, and challenges collected from key partners during the steering committee meetings and through other conversations.
3. **Travel surveys** including data from a 2015 state-conducted regional travel survey (called TwinCATS), which included respondents in the study area.
4. **Travel needs survey** conducted by the project team from 2017 to 2019. The project survey was a targeted survey on the travel behaviors of more vulnerable travelers, including low-income, transit-dependent, un/underemployed, and elderly travelers. A subsample also participated in a GPS-based survey.
5. **Trip-level data from the demand-response system** logged by PCTrans, TCATA's scheduling software.
6. **Fixed route ridership data** created by the project team via GPS and camera devices installed on TCATA buses to create data from video imagery describing when and where riders board and alight the buses.

In addition to these major sources, we used various geographic information system (GIS) data for contextual mapping, and SafeGraph data to analyze points of interest and mobility patterns (see Goodspeed et al., 2021). The project utilized three primary computational modeling tools sequentially to develop and analyze the scenarios: a travel demand model, an optimization model, and a sketch-planning model. First, a small-scale travel-demand model was developed to estimate mode and destination travel behavior between travel analysis zones in the study area. To develop the model, we combined primary data from the 2017–2019 Travel Needs Survey and 2015 TwinCATS household travel survey. This data combination consisted of both stated preferences (SP) and revealed preferences (RP) data. The first focused on people's behaviors based on hypothetical scenarios, while the second involved people's actual behavior under current conditions. Additional data from a travel needs survey conducted by the project was used to provide greater representation of general travel in the study region, but also more sensitivity to transit ridership (absent from the TwinCATS travel demand model) and to the preferences of vulnerable travelers.

Second, we used an optimization model to analyze how travel needs related to future transit services. It was used in two ways. First, it was

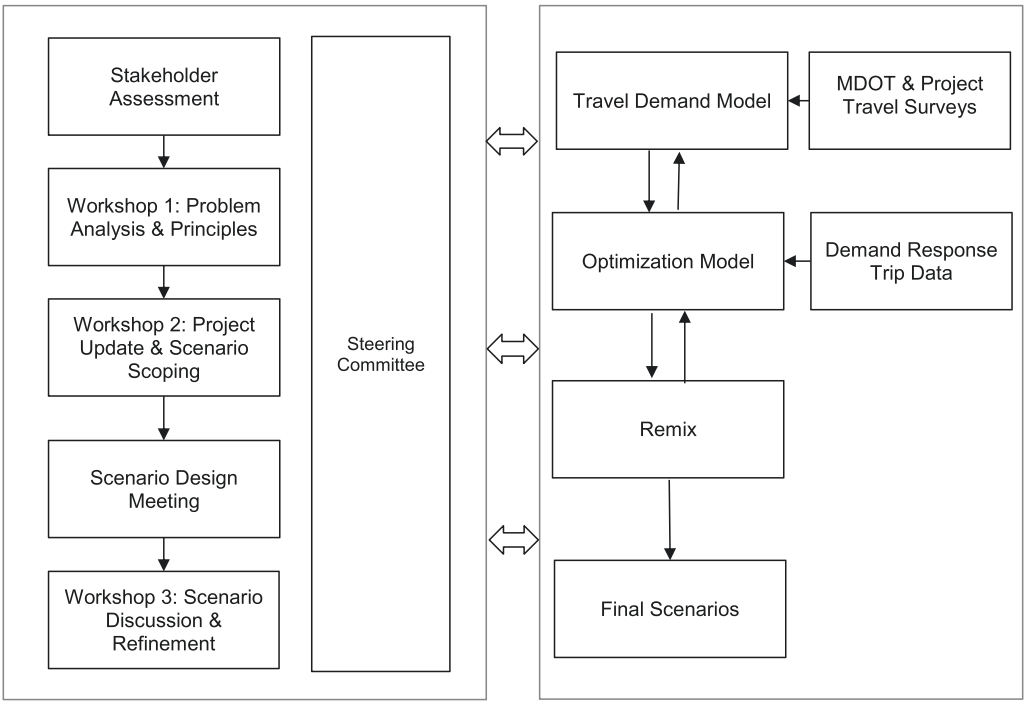

Fig. 3. The project scenario planning process featured extensive interaction between stakeholder workshop and engagement and the project's data collection, modeling, and scenario-building activities.

used to propose possible new routes that would best satisfy modeled demand. Seven separate optimization models were created to reflect various input data, assumptions, and constraints. Each analysis resulted in a sequence of travel analysis zones that could be linked by a hypothetical bus route. The new bus routes were then fed into the travel demand model to capture the changes in travel patterns as a result of the introduction of the new bus routes. This iterative procedure between the travel demand and optimization models continued until no changes in bus routes and ridership were observed between two consecutive iterations. These finalized bus routes were then converted from a sequence of transportation analysis zones (TAZs) into conceptual routes along streets. These routes were examined and discussed during the monthly steering meetings, as well as during the scenario design meeting by the project team. The group decided not to directly use any of the routes in the scenarios because this would be potentially confusing to riders and operationally difficult to implement; however, via the modeling output the team identified parts of the region that were a priority for new service.

After creating the service scenarios, we used the optimization model to calculate some performance metrics from the final scenarios. The modeled demand was assigned to routes assuming that each passenger would select the best route (that is, the route with the shortest travel time and respecting bus capacity limitations). These routes could include transfers, and the waiting time at transfer stops was accounted for in calculating the total travel times. For each scenario, we processed the optimization results to provide information on the total ridership for each scenario, and the distribution of number of transfers, among other metrics.

The final model we used was Remix, a web-based transit sketch planning tool. We used this model during the scenario design meeting to sketch the routes in real time with project stakeholders. In addition, we used this model to compute several performance metrics, such as the number of jobs and demographics of residents near the routes contained within each scenario. As illustrated in Fig. 3, the data and modeling were closely integrated into the process. The data and models were discussed frequently during monthly project meetings. Special meetings were held in June and July 2021, among the project team and SWMPC and TCATA staff to examine the assumptions and details for the travel demand and optimization models. The final scenarios and performance metrics were reviewed at several internal meetings and shared with key stakeholders before being shared more broadly during the final workshop on May 13, 2022.

6. Process evaluation

A survey was conducted among all community stakeholders who participated in the three main workshops (denoted as Workshops 1 through 3 in Table 1) to evaluate the process as well as seek project-specific feedback.[2] Our evaluation was guided by collaborative planning theories, which specify the desired outcomes of collaborative processes. As a result of the diversity of theory on collaboration, we decided to measure several somewhat different outcomes. One useful basic framework was introduced by Booher and Innes (2002) as their Diversity, Interdependence, and Authentic Dialog (DIAD) model, which proposes that collaborative planning has three key elements. First, *diverse* and *interdependent* stakeholders come together to address a shared problem. Second, they engage in *authentic dialogue*, which is characterized by reciprocity, relationships, learning, and creativity. Finally, the process results in *system adaptation* outcomes: shared identities, shared meanings, new heuristics, and innovation.[3]

The first key outcome we measured was learning, a well-recognized goal across multiple theories of collaborative planning. To measure it we included a question widely used in educational contexts, which asked whether participants "learned a great deal" with a Likert response scale. To measure authentic dialogue, we used a deliberation quality index developed by Goodspeed (2015) and inspired by Argyris and Schön's (1996) concept of double-loop learning. The index contains five

[2] Individuals excluded from the survey included participating university faculty, student research assistants, and the two project consultants.

[3] This model is broadly consistent with other, somewhat detailed frameworks, such as the one proposed by Ansell and Gash (2008) for collaborative governance.

Fig. 4. Photos from workshops 1 (top) and 3 (bottom). Credits: Brittany Simmons and Curt Wolf.

questions probing whether participants thought they were listened to, had their questions answered, and engaged in open discussion, as well as whether alternative views were considered. These strongly describe the qualities of authentic dialog from collaborative planning theory. Next, we sought to probe attitudes that more directly related to the potential for innovation, such as novel funding or implementation arrangements we hoped our process might encourage. Therefore, we asked a set of questions derived from the work of Elinor Ostrum, describing different requirements for effective collaborative governance of shared resources (Dietz et al. 2003). These included items like "we can cooperate and work together to improve mobility" and "I am willing to communicate often with others to improve mobility," asked on a scale ranging from complete disagreement to complete agreement.

The survey also collected age and race data at each workshop, and gender data at Workshops 1 and 3. At the suggestion of the team, questions about the participants' place of residence and work and their usual modes of travel were added for the second and third workshops to help gauge the backgrounds of participants. Workshop-specific questions asked participants for suggestions of stakeholders to invite (Workshop 1), explored apps and mobility concepts of interest for the scenarios (Workshop 2), and included a set of questions concerning a data dashboard (Workshop 3).

The survey mode depended on the nature of the event. The survey at Workshop 1 was conducted as a paper survey at the conclusion of the workshop. At Workshop 2, held via Zoom, the survey was administered as a Zoom poll, as well as via a web-based survey circulated among the stakeholders with slides for those who could not attend to contribute their views. The final Workshop 3, held as a hybrid in-person and online event, involved both a paper survey conducted in person and an online survey distributed among the online participants.

7. Results

This section presents two types of results from our methods. First, we provide a description of the scenario planning process to show how it was conducted and how it shaped the project products, and to describe the specific scenarios that were created. Second, we describe the results from the evaluation survey conducted during the three key workshops, providing an evaluation of the scenario process.

8. Scenario planning process

Consensus about the scope of the project, and how community needs, data, and modeling would be incorporated within specific scenarios, emerged through the process (Fig. 4). At the project onset, although public transit service provided by TCATA was a major focus, the participants in the project adopted a broader concept of mobility, and there was considerable interest by some stakeholders in novel solutions, such as ridesharing services and community-based transportation services, among others. During the course of the project, it became clear to the team that TCATA was the primary asset available in the community to serve mobility needs, and TCATA expansion scenarios were identified as the top mobility priority during the workshop survey conducted in June 2020. The scope of the scenarios was fixed-route services, on-demand services, and flex routes or smart options.

Another area where consensus was developed was the appropriate geographic scope for analysis. TCATA was originally a regional agency with multijurisdictional funding and board representation; however, the other municipalities withdrew years ago, leaving City of Benton Harbor as the sole local jurisdiction providing funding. Therefore, the Benton Harbor mayor appoints all board members. However, TCATA receives federal urbanized area formula funding to provide service outside the city limits. For pragmatic reasons, TCATA operates fixed route and demand-response services to many destinations outside of the City of Benton Harbor (such as medical facilities, big box retailers, and a community college). A previous Berrien County transit plan, which proposed merging all county agencies and offering services to primarily serve cross-county transportation needs, resulted in concerns about degrading Benton Harbor services. Through the collaborative process the team decided to use the City of Benton Harbor and six adjacent jurisdictions that contain the present TCATA service area, resulting in a contiguous area suitable for modeling.

As described, a major emphasis of the process was to effectively integrate the multiple sources of data and forms of knowledge. One product created during the planning process that illustrates this is the map shown as Fig. 5. The map illustrates the fixed route service in the context of two additional data layers. A raster heat map shows the density of trips provided by TCATA through its demand-response service, Dial-a-Ride. In addition, the map shows some key locations gleaned from stakeholder interviews and input. This map helped participants understand the specific geography of the region and set the stage for discussing the concrete service scenarios.

A final issue was determining the appropriate types of scenarios to create. Although many mobility needs exist in the community, TCATA has funding limitations. Therefore, for the concrete service scenarios, we created two scenario categories: *fiscally constrained* and *service expansion* scenarios. Fiscally constrained scenarios illustrate how TCATA routes and services might be modified to better meet Benton Harbor residents' mobility needs, without assuming additional financial resources. Service expansion scenarios illustrate the potential benefits for Benton Harbor residents' mobility created by service expansions that would assume a plausible increase in TCATA resources. We compared both scenario types with the current system. Additional, qualitative narrative

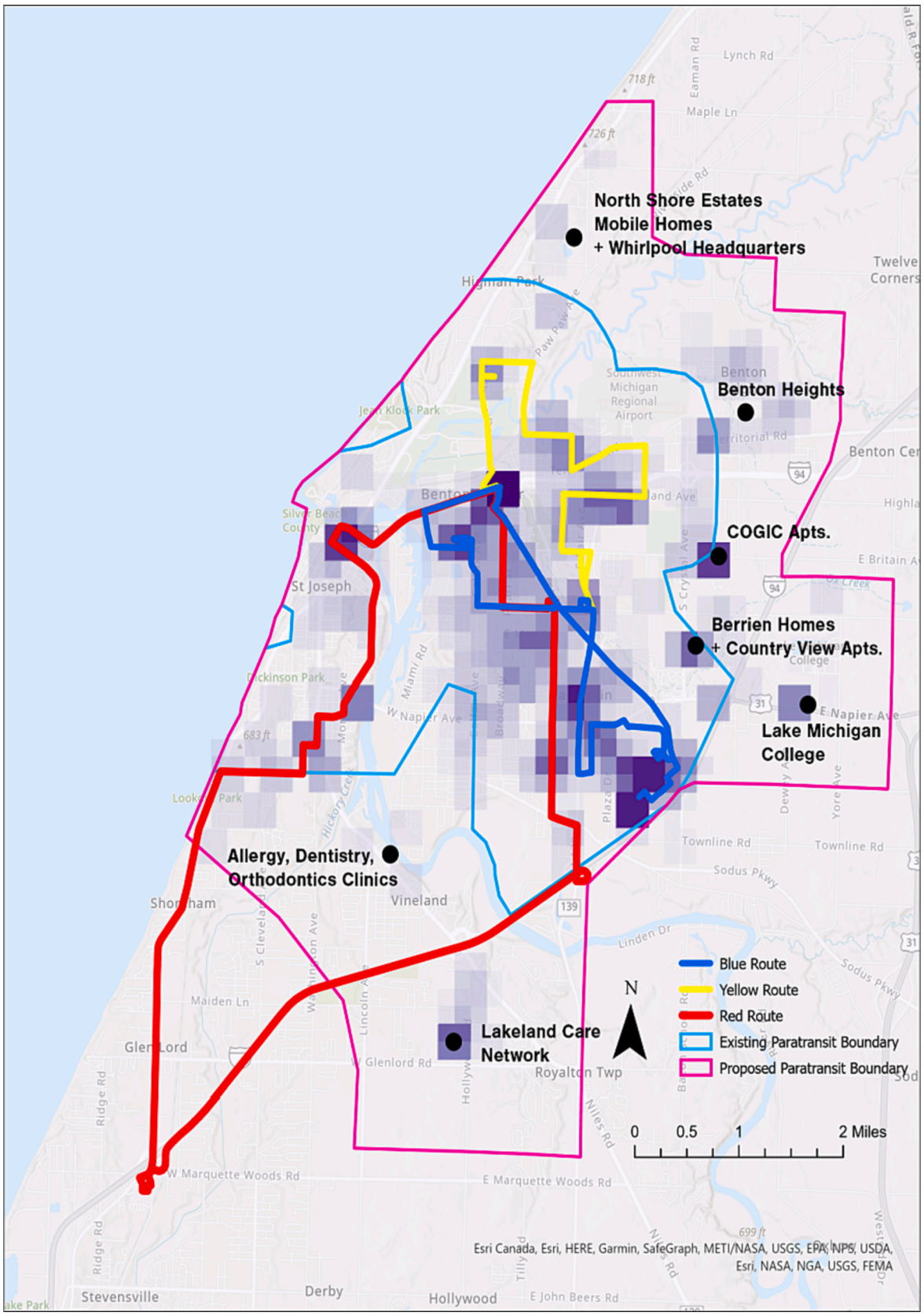

Fig. 5. Map illustrates the fusion of multiple sources of information, showing demand-response trip density, key destinations from interviews and stakeholder engagement, and existing Twin Cities Area Transportation Authority (TCATA) fixed-route services.

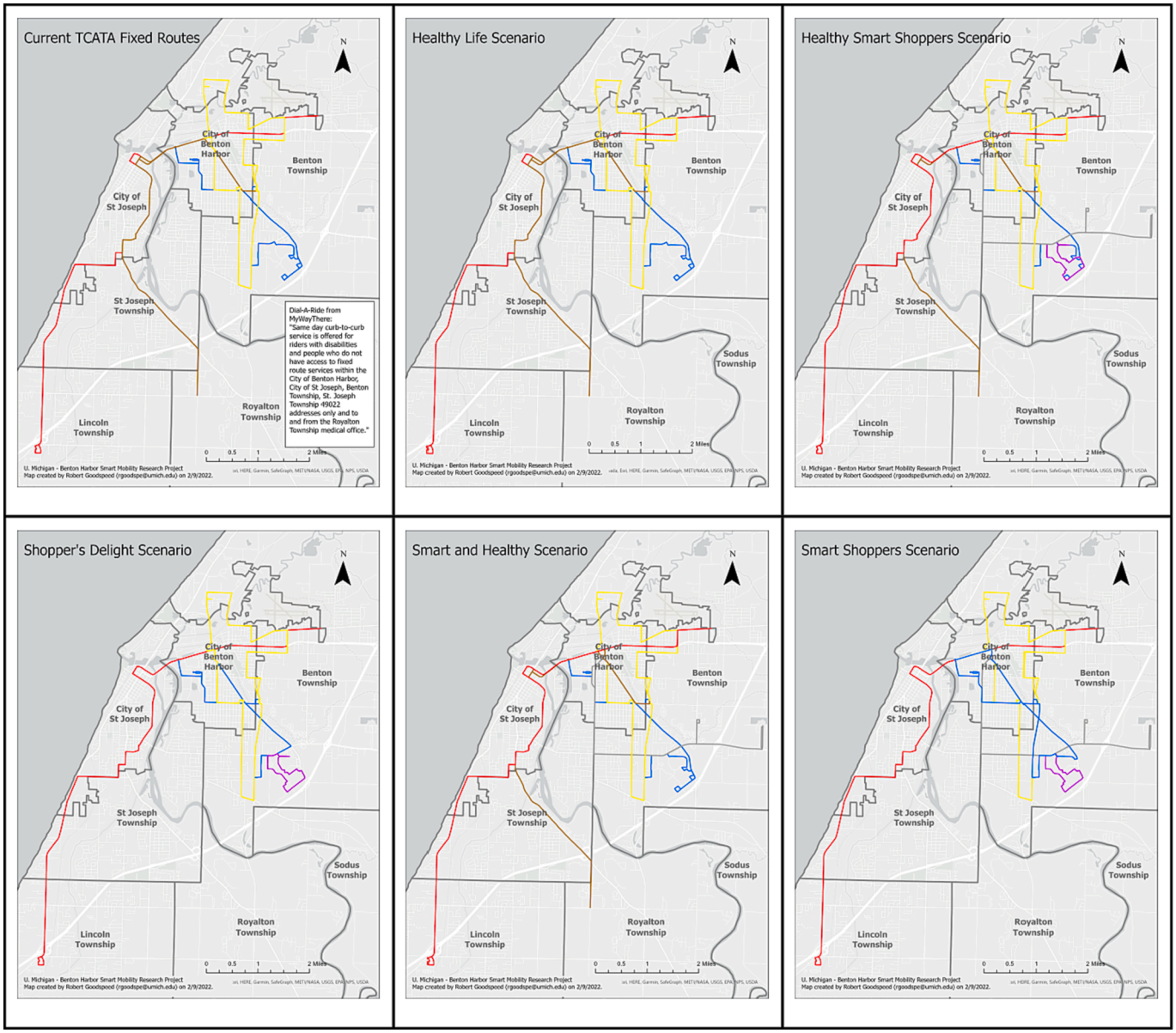

Fig. 6. Maps illustrating the current routes and the five service scenarios.

scenarios were also created to foster discussion about broader trends effecting the region's transit.

9. Scenarios

The planning process developed and utilized two scenario types: normative service scenarios and exploratory qualitative narrative scenarios. The concrete service scenarios described possible fixed routes. At the scenario design event, the group first discussed specific ideas for fixed routes, and then how they could be combined into service scenarios. There was a consensus that two existing routes, the Red and Yellow routes, could be modified to better serve the community. Therefore, all scenarios incorporated revised versions of these routes. The system's third existing fixed route, the Blue Route, appears in the scenarios in two forms: the current route and a modified route that terminates earlier as a result of launching a new shopping circulator. Additional routes proposed included a Brown Route, which would provide expanded services to popular medical destinations; a Gray Route, which would provide scheduled service to a large apartment complex, community college, and other destinations; and a Purple Route, which would serve as a shopping circulator in a commercial area containing a mall and big box retail stores. These routes were incorporated to create five scenarios (Fig. 6). The constrained scenarios were *Healthy Life*, which would add the Brown Route to the current system, and *Shopper's Delight*, which would add a shopping circulator. The service expansion scenarios were *Smart Shoppers*, which would add the Gray and Purple routes; *Smart and Healthy*, which would add Gray and Brown routes; and *Healthy, Smart Shoppers with Classic Blue*, which would add all new routes. The quantitative performance of these scenarios is reported in Table 2.

However, these service scenarios did not address other issues that had been identified through the planning process, such as how political obstacles could be overcome to realize greater revenue for the agency, and how decisions about vehicle technology, branding, and marketing might align with service goals. Furthermore, the team thought it could be valuable for the group to consider the possibility of the agency's closure, to underscore the importance of proactive management and governance. As a result, the project's principal investigator wrote four qualitative narrative scenarios and circulated them among the steering committee members. After the steering committee made minor changes,

Table 2
Twin Cities Area Transportation Authority (TCATA) scenario performance summary.

	Metric	Source	Current System	Healthy Life	Shopper's Delight	Smart Shoppers	Smart and Healthy	Healthy, Smart Shoppers with Classic Blue
System Performance	Total annual fixed-route ridership	Optimization model	136,266	253,066	186,885	225,829	360,144	360,144
	Total demand response ridership	Optimization model	140,160	128,480	105,120	128,480	99,280	99,280
	Total transit ridership	Optimization model	276,426	358,186	315,365	354,309	459,424	459,424
	Estimated operation cost	Spreadsheet formula	$1.25 M	$1.68 M	$1.68 M	$2.85 M	$3.15 M	$3.44 M
Efficiency & Accessibility	Population living within 0.5 mile radius of TCATA fixed-route stop	Remix	26,900	29,800	27,300	29,500	32,600	32,600
	Number of jobs accessible within 0.5 mile radius of stops	Remix	18,100	19,600	18,100	18,700	20,400	20,400
	Average wait time of transfer	Optimization model	0.0	5.1	1.0	1.0	6.4	6.4
	Average trip time	Optimization model	10.0	11.3	10.0	11.8	15.6	15.6
	Number of schools within 0.5 radius of stops	Remix	26	35	27	30	38	38
Equity	% Non-White	Remix	56 %	53 %	57 %	57 %	53 %	53 %
	% Households car-free	Remix	17 %	16 %	17 %	17 %	16 %	16 %
	% People with a disability	Remix	19 %	18 %	19 %	19 %	18 %	18 %
	% Below poverty threshold	Remix	29 %	26 %	29 %	28 %	26 %	26 %
	% People 65 + or under 17	Remix	40 %	41 %	40 %	40 %	41 %	41 %

members read aloud the revised versions during the final workshop prior to participants engaging in a breakout discussion exercise, where they were asked to react to them. Illustrative excerpts of these scenarios are provided in Fig. 7.

10. Evidence of learning

Participants responding to the evaluation survey reported consistently high measures for self-reported learning, deliberation quality, and mobility collaboration optimism throughout the three workshops (Table 3). The average age of participants declined slightly across the three workshops. In terms of race, the percentage of Black participants increased from 18 % to 56 %, largely the result of the absence in later workshops of earlier stakeholders who lived outside the TCATA service area.

Among the questions included in the panel on optimism for the mobility planning process, three had the most consistently low responses. Respondents provided lower responses to the question, "Improved mobility will benefit me directly," although the mean score (2.1 for workshop 1, 3.0 for workshop 3) corresponded with "somewhat agree." Two other questions with lower scores were "We can come to an agreement on how to improve mobility" (3.7, 3.4) and "Local stakeholders have the ability to improve local mobility" (4.2, 3.7), reflecting the challenges of regional collaboration and expanding resources for transit.

11. Discussion

The context we encountered at the start of our project is similar to that of many small transit agencies. Although providing a vital community resource, the agency's routes had not been modified in many years and agency leaders, as well as community stakeholders, had many ideas about how service could be changed to improve mobility. However, the community lacked the capacity to capture the appropriate data and develop data-driven scenarios. The available travel survey data, gathered by a state agency, contained few respondents who were transit users, and used an overly coarse geographic unit not suited for route planning. A regional planning agency provided some GIS mapping capability and had mapped the locations of demand-response trips, but lacked capacity to sketch and model routes systematically. The transit agency itself had disparate data, such as trip-level data from dispatching software, but lacked the methods and capacity to draw upon them and community knowledge to develop proposed routes.

We experienced a relatively high degree of engagement throughout the entire process among community stakeholders, despite it overlapping with the pandemic, which introduced many challenges. During the project, the agency executive director decided to launch a new route (the Yellow Route) on an experimental basis, which operated from early 2020 through 2021. Although it was discontinued because of low ridership, a portion of this route was incorporated into the scenarios.

Although the full scope of the activities described here depended on a relatively large grant and the involvement of a large university-based research team, we think a streamlined version of our method could be replicated in other communities with access to resources that are typical for planning studies. In summary, the core components were:

1. The creation of a **steering committee**, including not only the operational agency but also other community stakeholders and the individuals conducting the planning study. In our case, the group included representatives from the city government, a regional planning agency, a workforce development organization, and academic participants with technical expertise.
2. The use of a **stakeholder analysis**, to identify stakeholders through snowball sampling and use interview transcripts to create shared knowledge by the team of all facets of mobility problems in the community.
3. The use of a **structured scenario process** featuring workshops geared toward problem analysis, scenario generation, and scenario discussion and refinement.
4. The development of **normative service scenarios**, analyzed through diverse metrics, and **exploratory qualitative scenarios** to foster consideration of long-term strategic issues.
5. Close **interaction between the data and modeling**, steering committee, and broader stakeholders, to ensure the tools are used in appropriate and tailored ways.

We recognize that conducting such a process probably requires greater resources than a more conventional planning study, which might utilize existing data and standard modeling or expert opinion to propose routes that would be shared with the community. The critical resources

Scenario 1: A Smart, Flexible Transit Future
In 2032, a new era of transit has arrived in Benton Harbor. Dial-a-Ride as it was known is no longer; instead a fleet of freshly painted snazzy blue and green buses plies city streets. … Beyond the snazzy new fleet, the buses travel to lots of new places. Novel arrangements have generated revenues and added board members for Benton Township, the City of St. Joe, and Royalton Township. [...] In 2028, President Kamala Harris visited Benton Harbor, noting that the successes seen there were a model for small cities nationwide and demonstrated the transformational potential of the Bipartisan Infrastructure Bill's enhanced funding. The region is still racially segregated, but increasingly BHForward is attracting diverse riders. It's not unusual to find Whirlpool employees, seniors going to get groceries, and vacationers sharing the same buses. This has led to a feeling that the social climate is changing in the region, with a growing awareness of their interdependence to achieving a brighter future.

Scenario 2: Benton Harbor Becomes a Mobility Desert
Unfortunately, in 2032, TCATA/Dial-a-Ride does not exist, and the downtown headquarters sits vacant. This has caused major problems for the community formerly dependent on the agency, especially the elderly and those who do not have reliable automobiles. In 2022, after their triennial review, the Federal Transit Administration put the agency on probation. Despite heroic efforts from a newly hired executive director, in 2024 the FTA concluded not enough progress was being made. Reluctantly, the FTA stopped all funding. With the only remaining funds from the City of Benton Harbor, the agency quickly ran out of operating funds. [...] Meetings have begun about how to form a new transit agency to serve community needs. However, it seems likely that the City of Benton Harbor will be a minority on the new board, and business and political interests from elsewhere in the county have a big voice in the future of transit.

Scenario 3: Stuck in the Mobility Past
In 2032, Benton Harbor has continued to change, but standing in the lobby of TCATA you'd never know it. As the executive director fumbles to unlock the door, you see some familiar faces. Drivers and maintenance and administration workers are paid higher salaries and have a high level of professional performance, and staff morale has never been higher. Buses are running on time, and riders seem happy, even though ridership has slipped a bit. Despite some ideas generated from a U-M proposal in 2022, the agency has been reluctant to make any changes. Bitter arguments have pitted those who prefer fixed routes against those who like the demand-response service, and surrounding jurisdictions have remained unwilling to lend financial support, despite their residents riding the bus. Meanwhile, the region has continued to change, with more and more doctors' offices, jobs, and shopping moving farther from downtown Benton Harbor. Combined with ongoing population declines in the city, these changes can be seen in slipping ridership numbers in recent years. Although rare a decade ago, more and more Ubers and Lyfts can be seen in Benton Harbor, and their competitive rates are attracting more riders. Younger riders especially like the ease and convenience of using an app and seeing a minute-by-minute countdown, instead of calling Dial-a-Ride and waiting a long time for the bus to show up.

Scenario 4: A New Region Through Transit
One of the best things about living in the Benton Harbor/St. Joe region is TCATA. Stepping onto a quiet, clean, electric bus at the new transit center, funded by an FTA new facilities grant received in 2023, riders are whisked to a wide range of destinations. At first glance, the colorful route map looks similar to the past, but quickly you notice new routes running to Hollywood Road and Lake Michigan College, and even express routes to Bridgman and Kalamazoo. The impetus for the changes came in 2022 when ideas for more routes were floated, piquing the interest of several local organizations. Initially the routes were sponsored by the institutions they served, but their popularity convinced the local jurisdictions to enter into funding agreements. Some of the money paid for attractive bus shelters and sidewalk improvements at key locations. Initially it was rough going because many old-time riders were used to calling for rides, even those along the bus routes. But with more funding and ridership, service became more convenient and reliable. […] One of the agency's newest electric buses crossed over the bridge during the Blossomtime Festival, decked out with electrically lit flowers created by a local artist. The event symbolized a profound change that had occurred: transit was no longer a dreary afterthought, but a key point of pride for the region. Because the investments were led from a hub in Benton Harbor and controlled by the Benton Harbor community, it boosted community pride and quality of life in Benton Harbor.

Fig. 7. Excerpts from narrative scenarios used in workshop 3.

required for our approach are an individual to serve as the process manager to define and orchestrate the process, support staff to assist with interviews and organizing workshops, and staff engaged in technical activities like modeling and GIS mapping. Although our process took four years, this was in part because of disruptions caused by the pandemic, and we think it could be conducted within two years. Another noteworthy aspect of our project is the deliberate inclusion of both normative and exploratory scenarios, which allows for the project to benefit from the strengths of each, as suggested by Avin and Goodspeed (2020). Although we received positive comments from project participants about the exploratory scenarios, they were only used during a brief exercise during the third workshop and future projects could strengthen their connections to decision-making such as using them to develop and test strategies (Avin et al., 2022).

We think the additional effort of a more collaborative approach has many benefits. First, it ensures that community perspectives shape the use of data and modeling tools. Second, it facilitates the synthesis of different forms of knowledge not possible through a single technical analysis. Third, it results in a plan containing greater detail, and with greater community support, than one created without robust involvement.

Collaborative planning is a necessary but not sufficient ingredient toward greater transportation justice. Although we produced a plan that was shaped in many ways by the preferences, knowledge, and priorities

Table 3
Workshop survey results of respondent learning, deliberation quality, collaboration optimism, and demographics. *Notes*: Not all questions in the deliberation quality index, and the question about respondents' gender identity, were asked during workshop 2 due to poll constraints. A standard deviation for the mobility collaboration optimism index could not be calculated because Zoom poll responses for some users were recorded separately. Percentages for race do not equal 100% because of rounding.

	Workshop 1	Workshop 2	Workshop 3
N	17	18	10
Response rate	63 %	n/a	56 %
Self-reported learning (1–7), (SD)	5.7 (0.60)	5.8 (0.51)	6.1 (0.88)
Deliberation quality index (7–35), (SD)	32.3 (2.37)	*	31.9 (3.03)
Mobility collaboration optimism (-35–35), (SD)	27.7 (9.49)	28.9	29.4 (8.87)
Demographics			
Average age	50.3	47.2	44.6
Female (%)	40	n/a	30
Race			
Black (%)	18	39	56
White (%)	59	56	44
Asian (%)	6	0	0
Other or n/a (%)	18	6	0

of the community served by the transit system, our project did not address a lack of regional funding and cooperation, produce greater support from a state transportation agency, or fully address the agency's lack of capacity to successfully win competitive grants. Drawing on regional transportation collaboration in Chicago and Los Angeles, Weir, Rongerude, and Ansell (2009) argued that even successful *horizontal* collaboration (such as this project) is not enough to spark a virtuous cycle of transportation reform and that instead reformers must be able to leverage *vertical* power at multiple levels of the political system. Despite our deliberate inclusion of county and regional elected officials, as well as the state transportation agency, the project as of yet has not resulted in broader institutional changes necessary for obtaining the greater resources required for implementation. However, we agree with Karner et al. (2020) that future progress on transportation justice will require "novel combinations of state and society-centric strategies … [that] bring transportation planners and advocates into new collaborative relationships and elevate the concerns of disadvantaged communities" (452).

12. Conclusion

Small transit operators face many challenges, often operating in places where transportation funding and elected official support are focused on infrastructure for private automobiles. Yet, in Benton Harbor, like in many cities in the U.S., these agencies have continued to address local mobility needs through dedication and the resourcefulness of their staff and local communities. However, all infrastructures must evolve with community dynamics, and our case study illustrates the typical context where the existing service is not well aligned with evolving community needs.

To assist the community in better addressing mobility needs, we designed and implemented a collaborative and data-driven process that sought to integrate different forms of knowledge. The process utilized normative service scenarios to generate financially and operationally feasible proposals that the community could implement in the future, and speculative exploratory qualitative scenarios to foster constructive dialogue about how the community could move forward. Survey data show that participants experienced high levels of learning, engaged in quality deliberation, and were generally optimistic about the potential for improved transit. Nonetheless, good planning alone cannot overcome the resource and civic constraints the agency faces, which is also reflected in our surveys through lower optimism about the region's ability to implement participants' ideas. Lacking internal capacity or the strong support of the statewide transportation agency, despite the existence of a historic amount of funding available for transit agencies, they have not yet applied for any of the competitive grants funded by the Infrastructure and Jobs Act. The formula funding that provides most of the TCATA budget is only expected to modestly increase, and will be used to cover rising wage and fuel costs. However, a dynamic new TCATA executive director has begun to upgrade internal information technology systems and in the coming year may implement pilot routes and service offerings.

More broadly, our project demonstrates how transit planning can be conducted through a collaborative process with five features: a steering committee, stakeholder analysis and engagement, a structured scenario process, use of both normative and exploratory scenarios, and interaction between the process and models. Although, like all planning, implementing a process requires resources, we think it could be successfully implemented at different scales and for different types of projects. A collaborative approach requires a new set of assumptions and can make seasoned practitioners nervous because it deliberately leaves undefined some aspects of the project for the group to decide. However, it can result in analytically robust, well-vetted ideas, which may prove more useful and durable than the products of conventional methods. Given the myriad challenges and opportunities facing small transit agencies—like regional employment growth, changing rider preferences and destinations, climate resilience, on-demand mobility, and vehicle electrification—we see a great potential for collaborative scenario planning to design and plan the next generation of transit service.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethical Approval

All aspects of the study described here involving human subjects research were reviewed and approved by the University of Michigan's Institutional Review Board (ID #HUM00130174).

Availability of data and materials

Data and additional methodological documentation are available from the authors upon request.

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