Social Sustainability Guidelines and Metrics for Transportation in Louisville: A Proposal for TARC's APTA Sustainability Commitment

Authors: Ariel E. Weaver[1, 2], Peter Williams [1], Nathan Wright [1, 2], Ashley Woolsey [1], and Erin Yenney [1, 3]

University of Louisville, Department of Urban & Public Affairs [1]
University of Louisville, Department of Geography and Geosciences [2]
University of Louisville, Department of Industrial Engineering [3]

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Contact Information:

For inquiries into this project, please contact: Daniel A. DeCaro, Ph.D., Departments of Urban and Public Affairs and Psychological and Brain Sciences, 426 W. Bloom St., Louisville, KY, 40208, daniel.decaro@louisville.edu, or any of the student authors.

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ABOUT THE AUTHORS

Ariel Weaver, ariel.weaver@louisville.edu

Ariel is currently a graduate research assistant in the Department of Geography and Geosciences at the University of Louisville. Currently her research interests are broadly based in complex human – environmental interactions, climate, social and economic development, and policy. She utilizes remote sensing, GIS, statistical modeling, and other geospatial toolsets to better understand dynamic relationships between landscapes, people, and climate.

Peter Williams, peter.williams.2@louisville.edu

Peter is working to complete a Masters of Urban Planning and the University of Louisville. His interests include land use and environmental planning. Currently, he is a graduate research assistant contributing data analysis to transportation planning and economic research.

Ashley Woolsey, email: ashley.woolsey@louisville.edu

Ashley is currently in her first year of the Masters of Urban Planning program at University of Louisville. Her interests lie in community development and studying planning practices utilized in countries around the world.

Nathan Wright, nathan.wright@louisville.edu

Nathan is a second year graduate student in the Department of Geography and Geosciences at the University of Louisville. His current research interests are centered around themes of natural hazards, globalization, sustainability, and the urbanization of coastal areas. He uses Geographic Information Systems, remote sensing, and statistical models to investigate the complex interactions within these fields.

Erin Yenney, emyenn01@gmail.com

Erin is working to complete her Masters of Engineering in the Industrial Engineering Department at the University of Louisville. Her interests lie in addressing issues of sustainability from an engineering background, and is currently working on designing a virtual space that uses local knowledge to drive engagement and innovation around clean, safe water in developing communities.

"To explore and implement transportation opportunities that enhance the social, economic and environmental well-being of the Greater Louisville community."

Transit Authority of River City
Mission Statement

EXECUTIVE SUMMARY

The Planning 680 Sustainable Social-Ecological Systems Fall class of 2015 has been asked by Dr. Daniel A. DeCaro and the Transit Authority of River City (TARC) to layout the overall vision and framework of social sustainability for transportation in Louisville, accompanied by proposed indicators and metrics. We hope that this vision will help TARC meet and exceed the expectations of APTA's Sustainability Commitment in the future as well as revitalize transportation in the local community. The following proposal is comprised of a vision to integrate Transit Oriented Development (TOD) through central bus stop hubs that act as the home base for bus routes and travelers around the city, increasing connectivity, reducing barriers for potential riders, increasing sense of community and safety, and instilling a sense of place character in Louisville's transit system. Indicators have been proposed to serve as the areas that TARC can focus on in order to promote a more social sustainable organization and city, followed by metrics to use in understanding and measuring progress.

The overall vision of this project will require a long term plan and continuous support, as restructuring and building parts of the system will take time and commitment. Those committed to be involved should include TARC, city leaders, and regional stakeholders. Increased budget, investments from developers, grants, public acceptance, and local governmental support are resources required for implementation.

BACKGROUND

Globally, transportation is an enormous challenge to sustainability, as reducing greenhouse gas and chemical emissions worldwide are critical in order to mitigate the effects of climate change and reduce public health costs (Grimm et al. 2008). Within the US, reducing single occupancy vehicles is critical to reducing greenhouse gas emissions (Mitchell, 2014). According to the American Public Transit Authority (APTA), public transit systems consisting of "the greenest of earth-friendly, energy-efficient facilities and fleet" do little good if they are not utilized (APTA, 2011). Environmental policies and public institutions that do not address particularities of local context often reduce their efficacy and can even cause further harm to the community and the environment (Ostrom et al., 2007; DeCaro & Stokes, 2013). Public involvement in decision-making can contribute to development and maintenance of institutions that fit well to a community's social and environmental needs (Ostrom, 1990; Ostrom 2010; DeCaro & Stokes 2013). Ridership and public support are integral to the long-term viability of public transit systems, so it follows that the social dimensions of sustainability must be addressed in order to promote more sustainable public transit systems.

Sustainability has a colloquial connotation that often only focuses on the environmental dimension of sustainability, with emphasis placed on recycling and green technologies. However, within the literature on sustainability a more holistic definition of sustainability has emerged in the last several decades. The International Union for the Conservation of Nature (IUCN) and the United Nations Environment Programme (UNEP) define sustainability in terms of a balance between environmental conservation, social development, and economic development (IUCN 1980). According to Wheeler (2009), sustainability is based on "development that improves the long-term health of human and ecological systems." These definitions of sustainability highlight the importance of the social and economic dimensions of ecological sustainability, and provide a point of intervention where we can adapt our systems to be better stewards of the environment as well as improve local livelihoods.

We aim to provide a framework to improve the social sustainability of Louisville's public transit system, the Transit Authority of River City (TARC). We draw from several social-ecological system principles in order to conceptualize a socially sustainable vision for the long-term viability of TARC and the improvement of public transit services to the greater Louisville metropolitan area. The social-ecological principles that we specifically draw from are based on frameworks of social fit (Ostrom, 2007; Epstein et al., 2015), public participation (DeCaro & Stokes, 2013; Arnstein, 1969; Davidson, 1998), and the Transtheoretical Model of behavioral change (Fu et al. 2012).

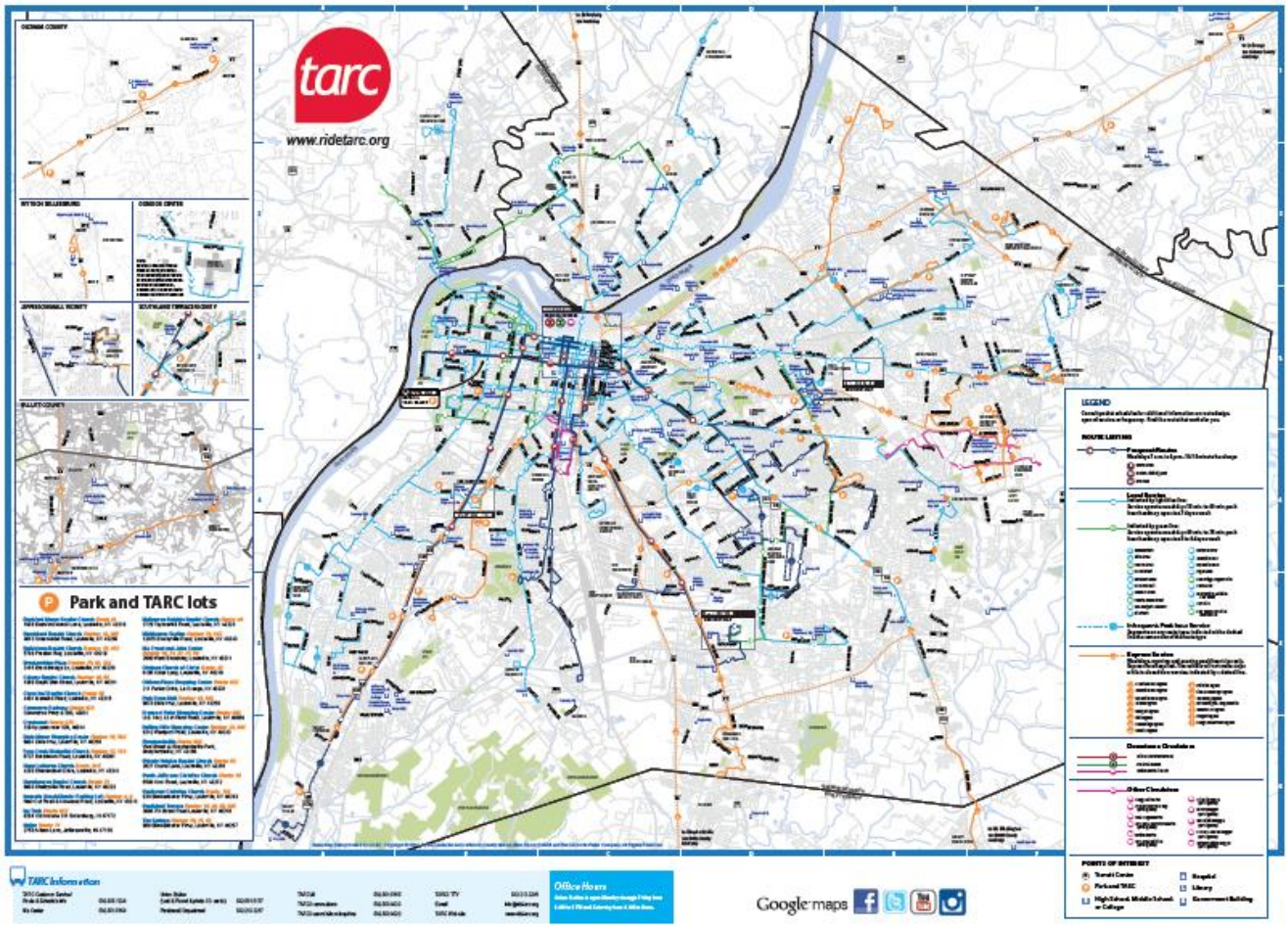
Public Transit Situation in Louisville Today

TARC services 41 bus routes within 5 counties in Kentucky and southern Indiana (TARC, 2015a). As the major public transit provider for the greater Louisville metropolitan area, TARC averages approximately 47,000 daily riders (TARC, 2015a). However, this pales in comparison to the US Census Bureau's 2014 population estimates of 1,235,708 for the Louisville metropolitan area (Census, 2015). Perhaps this means that many in the population are either unaware of the consequences of their behavior or estimate the cost of taking public transit as

being too difficult or time-consuming. Getting a better understanding of what the community at large needs, will help TARC target specific actions in order to increase awareness of the safety and environmental benefits of riding public transit and increase accessibility to those who are in the process of contemplating or preparing to switch over to public transit.

Louisville's transit system is highly fragmented and extremely complicated to navigate. In figure 1, below, TARC's complete route map is a series of tangled routes. In order to switch to certain bus lines downtown, you have to cross several blocks to change buses. Having no central bus station or hubs around the city, bus travel in Louisville can be quite challenging and time-consuming. The Development of Louisville's built environment has been driven primarily motor-vehicle oriented (Riggs, 2014), as many streets are not pedestrian friendly or safe. According to the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA), Louisville's rate of pedestrian death is much higher than the national average, and in 2013 twenty percent of all fatal traffic accidents in Louisville involved pedestrians (NHTSA, 2013). A lack of sidewalks in certain areas compounds the problems that pedestrians face in Louisville-- if people can't walk to bus stops safely, they'll be more likely to continue to drive single-occupancy vehicles.

Figure 1. TARC Service Map



This inefficiency and subsequent safety concerns have weakened TARC's positioning as an attractive method of transport in the local community. Many residents find the route network too complicated and cumbersome. Long wait times on pickups and transfers have been a barrier to entry for many in the modern microwave society of instant gratification. This often leads to potential riders avoiding TARC unless there is no other option and deters many who could benefit from the service to consistently opt for inefficient single passenger vehicle transit instead.

However, on a more positive note, TARC has been actively involved in the community and culture scene in Louisville through their trolley circulators. TARC's trolleys service along downtown Main Street, the First Friday Trolley Hop in NuLu, and the Frankfort Avenue Trolley Hop helps TARC maintain consistent service to important downtown attractions and connects TARC with art galleries, museums, and local businesses (Transportation Copperative Research Program, 2011). According to the Transportation Cooperative Research Program's report in 2011, the Friday trolley hops "are worth their weight in gold," as TARC's service is connected to Louisville's vibrant cultural scene. Fitting TARC to the wider social needs of Louisville will not only continue to improve its image, but will make it stronger part of the social fabric of the city and increase public acceptance and support.

VISION

The Vision, **"A Connected, Equitable, and Popular Transportation City",** outlines what we envision as a potential ideal scenario of socially sustainable transportation in Louisville. Our vision for the future of transit and sustainability in Louisville includes a multi-modal station (hub) system designed and built with the principles of transit oriented development (TOD). Transit oriented development not only increases residents' abilities to utilize alternative transit options, but it increases housing options, reduces traffic congestion, makes communities more walkable, and increases sense of community and place character. TOD doesn't require every trip to be made via public transit, however residents should have access to mass transit stations and the areas adjacent to them to combine work and non-work trips (Johnson, 2001). Perhaps most important however, transit oriented development promotes sustainability and addresses the key dimensions of social sustainability. We outline the ideal scenario here, and offer alternative scenarios of social sustainability, reflecting current economic and political constraints, in later sections (see Scenarios). Stating an ideal scenario first communicates the need and potential for next generation transportation systems in Louisville.

Visions take cooperation from multiple stakeholders, for example, TARC, developers, business owners, Metro planners, and general public, and also take a tremendous amount of time and money. However, Visions are essential to effective development, providing goals and milestones to guide decision making (Wheeler, 2009). Overall details of the program are outlined in Box 1. We describe the specific details next.

Box 1: Brief Overview of the Vision

A Connected, Equitable, and Popular Transportation City

1. **Transportation Oriented Development (TOD):** City is connected by multiuse transportation hubs, which provide a point of contact for travelers, as well as preserve cultural heritage and present a stage for economic development. Hubs improve navigability and efficiency, ultimately providing an attractive alternative to single-occupancy vehicles, helping to reduce environmental and human health impacts.

2. **Social Dimensions**
    a. **Social Acceptance:** Public and community stakeholder support ensures that relevant groups are motivated to create and sustain (e.g., fund and use) such a system. Social acceptance is impacted by all the other dimensions.
    b. **Public Participation:** Use of many ways for the public to get involved in the design, implementation, and feedback on transportation options satisfies ethical standards, as well as encourages social acceptance.
    c. **Social Equity and Public Health:** Upgraded facilities and multiple modes of transportation ensures equitable access to transportation opportunities and fair share of health impacts, including decreased disease associated with air quality, excessive heat, etc., among marginalized and low income citizens.
    d. **Identity and Heritage:** Preservation and emphasis of place-based identity (e.g., "Keep Louisville Weird") and historical heritage (e.g., Kentucky Derby) sustains that valuable resource and promotes social cohesion, trust, and economic development.
    e. **Safety and Security:** Streamlined system of transportation networks provides for decreased riding time, more perceived security, lower use of cars (which are dangerous), and increased usage of mass transit, which is safer.
    f. **Economic Viability:** Progressive transportation system boosts regional and local economy, enhancing visibility and accessibility of local business; increased tax base for public works of transportation improve long-term financial sustainability. Costs and benefits of the system are equitably distributed across citizens and stakeholders.
    g. **Usability and Efficiency**: A system which is easy and efficient to use will enjoy greater usage, increasing demand and support for alternative transportation.

1. TRANSIT ORIENTED DEVELOPMENT

Transit oriented development is compact development that includes a mixture of housing, office, retail, and other amenities integrated in a walkable community located near a high quality transit station. The transit stations allow residents unprecedented connectivity and choices. Each station provides many different transportation options including but not limited to: bicycle, car, bus, bus rapid transit, streetcar, light rail, and heavy rail. The type of transit station and the corresponding TOD depends on many factors such as density, intensity of use, type of use, residential or commercial, established or up and coming neighborhood, arrangement of existing streets, and the station's role in the larger region (citations?).

Although every station will face unique challenges that require specific solutions, below is a typology of stations to assist planners, developers, elected officials, and citizens determine the type of place and the appropriate station. We point out that hubs are scalable, which means that the size and sophistication can be adjusted to suit particular needs and restrictions. For example, a regional hub, as introduced below, can be rather modest in size and sophistication, so long as it provides suitable service and addresses key social sustainability principles (e.g., provides a cultural touchstone for a community). Many such hubs are quite modest, reflecting a pragmatic balance of economic efficiency, political reality, and transportation needs. Each station will be of the appropriate type and provide the appropriate services.

Station Typology

Station typology was created by Reconnecting America and The Center for Transit Oriented Development in their report "TOD 202 Station Area Planning".

Regional Center

Regional centers are often a major center of economic and cultural activity within a region. These centers are typically located in downtowns and may be characterized by dense (e.g., Chicago) or moderate housing and commercial, mix of employment types, and entertainment options that serve to the region at large. Because of their importance and scope, regional centers often provide a multitude of transit options including regional rail and bus, local bus, and bicycle infrastructure. However, regional hubs have been known to be rather modest in some localities, serving their primary functions without lavish services or amenities.

Urban Centers

Urban centers contain a mix of residential, employment, and entertainment options serving residents of other nearby neighborhoods but, at lower densities compared to regional centers. Urban centers preserve the historic character of a neighborhood or city. They are commuter hubs, which may offer a range of transit options including light rail, streetcar, bus rapid transit, local bus, and bicycle infrastructure.

Suburban Center

Suburban centers contain residential, employment, and entertainment options similar to urban centers. These stations may either serve as origins or destinations and are typically connected to the regional transit network while providing additional transit options such as bus rapid transit, local bus, and bicycle infrastructure.

Transit Town Centers

Transit town centers are local serving centers of economic and community activity. These stations primarily provide commuter service to jobs or other stations in the region by offering a variety of transit options including bus rapid transit, local bus, and bicycle infrastructure.

Other Considerations

- Urban Neighborhood
- Transit Neighborhood
- Special Use/Employment District
- Mixed-Use Corridor

Broader Development

In addition to developing a network of transportation hubs to serve as cultural centers, places of commerce, and transportation, there are many things that the city of Louisville can do to continue do to move the city closer to being socially sustainable. Each of these steps improves connectivity, improves popular support for transportation, and otherwise addresses vital efficiency and social aspects of sustainable transportation.

- Smart cards to make fare paying easier (currently being rolled out by TARC)
- Enhancements to sidewalks and pedestrian networks: walkable neighborhoods and safe crossing zones
- Additional and improved covered bus stops with clear and appropriate signage
- Use of local art and culturally specific terminology to retain and enhance social cohesion and place character

2. SOCIAL DIMENSIONS OF THE VISION

Our Vision for transit in Louisville is a well-connected hub system of transit stations and transit oriented development, supported by social sustainability (e.g., equity, acceptance), creating a "A Connected, Equitable, and Popular Transportation City". Sustainable transportation systems must be both effective and efficient, and contribute to overall vitality of a community (Wheeler, 2000, 2009). Therefore, our Vision creates a transit system that is also embedded with the themes of equality and human development (Wheeler, 2009), which address major dimensions of social sustainability.

We provide a framework through which TARC employees, city planners, and other community stakeholders can envision, implement, and measure progress towards reaching the social sustainability dimensions of the Vision. The major dimensions of this Vision are

summarized in Table 1: (1) Social Acceptance, (2) Public Participation, (3) Social Equity and Public Health, (4) Identity, (5) Safety and Security, (6) Economic Viability, and (7) Usability and Efficiency. Each dimension is accompanied by a short description, metrics, and a general assessment of where we perceive Louisville currently ranks on the dimension (poor, fair, good, or excellent) (see Kates et al., 2015; Wheeler, 2000, 2009, 2013 for comprehensive lists of sustainability dimensions and metrics).

(A) Social Acceptance

In terms of building more socially sustainable ecological systems, concepts such as "institutional acceptance" and "social acceptance" are extremely important. The concept of "institutional acceptance" is gauged in terms of the extent to which individuals endorse a particular organization's processes for decision making and the appropriateness of its activities (DeCaro & Stokes, 2013). Social acceptance refers more generally to acceptability of technological fixes, built environment, and polices (Wüstenhagen, Wolsink, & Bürer, 2007). Such acceptance would be a crucial component in making TARC more socially sustainable, for any proposed solution must ultimately be approved and supported by community stakeholders (e.g., business owners, politicians, general public). Many of the barriers for a hub system, such as lack of supportive political momentum and funding, could be lowered with stronger social acceptance from key community stakeholders (e.g., Smiley et al., 2014). Social acceptance could lead citizens to apply more political pressure for legislation that prioritizes public transportation. Legislation could be an opportunity to increase federal and state funding. Social acceptance is seen as a key component of social sustainability, which is also dependent on many other components (e.g., usability and efficiency, safety, cultural identity). For example, transportation systems seen as safe, efficient, and cultural appropriate will often be more acceptable. Therefore, we feature social acceptance prominently in the list of social dimensions.

Institutional acceptance is also a particularly important aspect of social fit (Epstein et al., 2015), because if key community members do not accept aspects of transportation, then this indicates poor social fit to that group (DeCaro & Stokes, 2013). Good fit is essential to long-term viability of any public work.

Metrics

Social acceptance could be measured by who the community votes for representation and if there is support for policies that emphasize transportation development.

Table 1. Dimensions of Social Sustainability

Component	Description	Metrics to Evaluate	Evaluation
Social Acceptance	Community acceptance and support.	Support (e.g., preference, willingness, acceptance) from targeted stakeholders. Trust and liking of various transportation modes and the system as a whole.	**Poor (-)** Widespread support for non car-centric mobility initiatives is lacking. However, high congestion, frequent accidents and delays decrease support of current system as well.
Public Participation	Involving and engaging the stakeholders in the process of decision making.	Type and number of participants; amount of responses; consistency of feedback. Changes in public awareness. Process of how decisions were reached (fairness, empowerment), and match to stakeholder needs, identity.	**Fair** Established methods to improve participation. Participation is being measured in some capacity, but specifics unknown. Concern for marginalized stakeholder groups, poor fit.
Social Equity of Public Health	Geographic and socioeconomic concentrations of pollution (air, noise, run-off).	Incidents of respiratory and cardiovascular disease, life expectancy, infant mortality rates, etc.	**Poor (-)** Pollution disproportionately affects the poor and racial/ethnic minorities living in the western portion of the Louisville Metropolitan area. Unequal outcomes in physical and mental health associated with mobility.
Identity and Heritage	Social cohesion, place character, cultural and historical heritage	Type and amount of culturally appropriate signage, art, themes, and historical sites. Citizen polls and evaluations of cultural preservation.	**Fair** Trolley circulators connect TARC to major cultural and economic centers, however, much room for improvement exists in incorporating and maintaining a sense of local identity.
Safety and Security	Crash risk, crime risk, perceived safety	Traffic accident stats; crime stats; citizen polls and evaluations.	**Poor (-)** Negative public perceptions of safety and security are not accurate, given positive safety and security of system as a whole. Low actual pedestrian and cyclist safety.
Economic Viability	Financial sustainability; economic equity of costs/benefits, funding opportunities	Operating budget (versus need and capacity); type and number of available funds secured. Equity of cost and benefits to different stakeholder groups (e.g., low income vs. high income).	**Poor (-)** Over budget (low tax rate); inequitable costs/benefits; rider demand growing faster than funding; room for economic improvement

		Economic development metrics (e.g., job creation, margins).	
Usability and Efficiency	Timeliness, convenience, and understandability or ease of use	Number and connectedness of transportation components (e.g., sidewalks, bus stops, etc.). Citizen polls and evaluations. Standard transportation metrics for efficiency.	**Poor (-)** to **Fair** System in need of upgrade to meet and increase demand, as well as consumer expectations, but City doing well with its limited available resources and infrastructure

(B) Public Participation

Public participation is a vital component from both a practical and ethical standpoint (Reed, 2008). Adequate and effective participation may improve design and implementation of transportation solutions, as well as satisfy social justice considerations for equitable treatment and due process (Bailey & Grossardt, 2010). In addition, the likelihood of public acceptance increases with appropriate, socially-acceptable forms of public involvement (DeCaro & Stokes, 2013). Thus, public participation, including due democratic process, is an important aspect of social sustainability in transportation (APTA, 2011; Bailey & Grossardt, 2010).

The location for any of the stations would be an example of how the public could be an invaluable resource. With the public's input, TARC could access where these hubs would have the greatest impact and success. It is also important to gauge the public's interest in the proposal and decide if it something the community wants or feels is needed. TARC (2013) has established a plan for proactive public engagement throughout its coverage area. They have clear methods of how to achieve higher public participation and have a process in place for "major fare and service changes". They also have an awareness about how to include those who are hard to reach such as those with limited English proficiency. They also state they measure and track the methods used and adjust accordingly, but no specific metrics are listed. There are also site-specific concerns of implementation (e.g., historic preservation), which often may only be uncovered upfront by direct public feedback (e.g., Bailey & Grossardt, 2010).

Implementation of Participation

Arnstein (1969) describes a ladder of citizen participation with eight rungs. The lower rungs are nothing more than illusions of participation. To obtain true levels of participation, marginalized and traditionally powerless citizens must be given the opportunity to have a voice and work with officials. It cannot be a one-way stream of information to citizens or merely an attempt to placate their concerns. Citizens must have real input into processes in which they are important stakeholders (Bailey & Grossardt, 2010). Thus, Arstein's (1969) Ladder warns against superficial participation, without genuine opportunity to influence design.

Arnstein's (1969) Ladder may be impractical or too restrictive in certain ways, so we caution readers that it is important to follow good process (see Grossardt, 2010; Reed, 2008), and

strive to offer multiple modes of participation (DeCaro & Stokes, 2013). These steps will ensure better, more genuine opportunities for different kinds of stakeholders to participate in transportation design, feedback, and implementation (Tritter & McCallum, 2006; DeCaro & Stokes, 2013).

There are many strategies that institutions can implement to encourage public participation, but it is important to consider the cultural norms, public expectations, and what is the correct fit for that situation (DeCaro & Stokes, 2013). Successful participation is inclusive to all stakeholders including, but not limited to, local people and businesses, operators of transit equipment, users of transit including those with specific accessibility requirements, health providers, etc. (Bathereram 2005). Some of the tools that can be implemented at a relatively low cost are things like social media, online surveys, and pamphlets. They are good places to start but cannot be used on their own. A supplement of other types of public participation would be necessary. Focus groups and face to face interviews can be more expensive and time-consuming. It is important to find the appropriate public participation strategy that fits the situation and to be mindful facilitating participation that is representative of the larger community (see IAP2 for a complete list of participatory methods and tips for implementing them).

Metrics

Measuring participation is imperative to finding which method is the best fit. This measuring is not an easy task. It can be challenging to decide what needs to be measured to indicate good participation. The first task is to have a clear definition of what success. It can be more quantitative information such as the number of participants, responses, etc. or more qualitative such as consistency of feedback, changes in public knowledge, etc.(Sale 2007). Measuring this participation can be a fruitful way to monitor progress, discover whether efforts have been effective, and understanding public opinion (Sale 2007). Another way to evaluate participation instead of measuring outcomes, to measure the process in which the outcome is reached. Angerbauer (2007) describes themes that can be observed to assess the level of participation. These themes include if the public's concerns and priorities were addressed and if so, to what extent. Another useful theme to use it looking at how the final decision was made and who made it.

(C) Social Equity of Public Health

Globally, 1.5 billion people currently live in polluted urban areas and with a projection of 65% of the total global population to be living in urban areas by 2025 (O'Neill et al. 2003). Additionally the impacts of greenhouse gas emissions globally affects the instances of the urban heat island effect, which can exacerbate health outcomes related to ambient air pollution (Xue et al., 2015). Environmental justice has become a topic of research within the United States, and there has been an increase in the number of studies linking uneven public health outcomes and socio-economic status (O'Neill et al. 2003). Air pollution has been found to be a contributing factor of increased incidences of disease and mortality, and globally has been found to cause 1.3 million deaths each year (Cartier et al., 2014).

Urban air pollution is a particularly important consideration to address in terms of social inequities (O'Neill et al., 2003; Cartier et al., 2014), especially in transportation (APTA, 2011). The Center for Disease Control (CDC) found that disparities in air pollution and related health effects are positively correlated with geographic location (CDC, 2011). In terms of public health, lower socioeconomic status residents and racial/ethnic minorities are disproportionately affected by higher levels of pollution from single-occupancy oriented transportation, and are more likely to use public transit (CDC, 2011; Glaesser et al. 2008).

Ambient air pollution has been associated with a large spectrum of health effects including respiratory and cardiovascular related disease and mortality (O'Neill et al., 2003). A recent study commissioned by the Louisville Partnership for a Green City found that a large proportion of air pollution (harmful particulate matter) in downtown Louisville comes from tires and exhaust of single-occupancy vehicles; vehicles also contribute greenhouse gas emissions, which contribute to the urban heat island effect and its impacts on health (Climate Action Report, 2009). A positive relationship between lower socio-economic status and poor public health outcomes in urban areas have been observed in numerous studies, with air pollution exposure unevenly impacting certain socio-economic groups (O'Neill et al., 2003). Lower socio-economic status health outcomes may also be impacted due to material deprivation, stress, and other factors that increase vulnerability to negative health impacts from ambient air pollution (O'Neill et al. 2003). Reduced life expectancy, increased daily mortality and hospital admissions, birth outcomes, and asthma are all indicators of the negative health outcomes from ambient air pollution (O'Neill et al. 2003). People who are affected by disabilities and low socio-economic status rely on public transit for access to healthcare and healthy food (Litman, 2010).

In Louisville, disparities are imminently apparent in terms of socio-economic status and along lines of racial segregation. Figure 2 is a map from Louisville Metro Government's Health Equity Report (Louisville Metro Government, 2014). Higher concentrations of lower life expectancies are reported in areas of the city where poverty is persistent and racial minorities are concentrated, particularly in the western portion of the county, concentrated near the central business district and along the west end of the Ohio River.

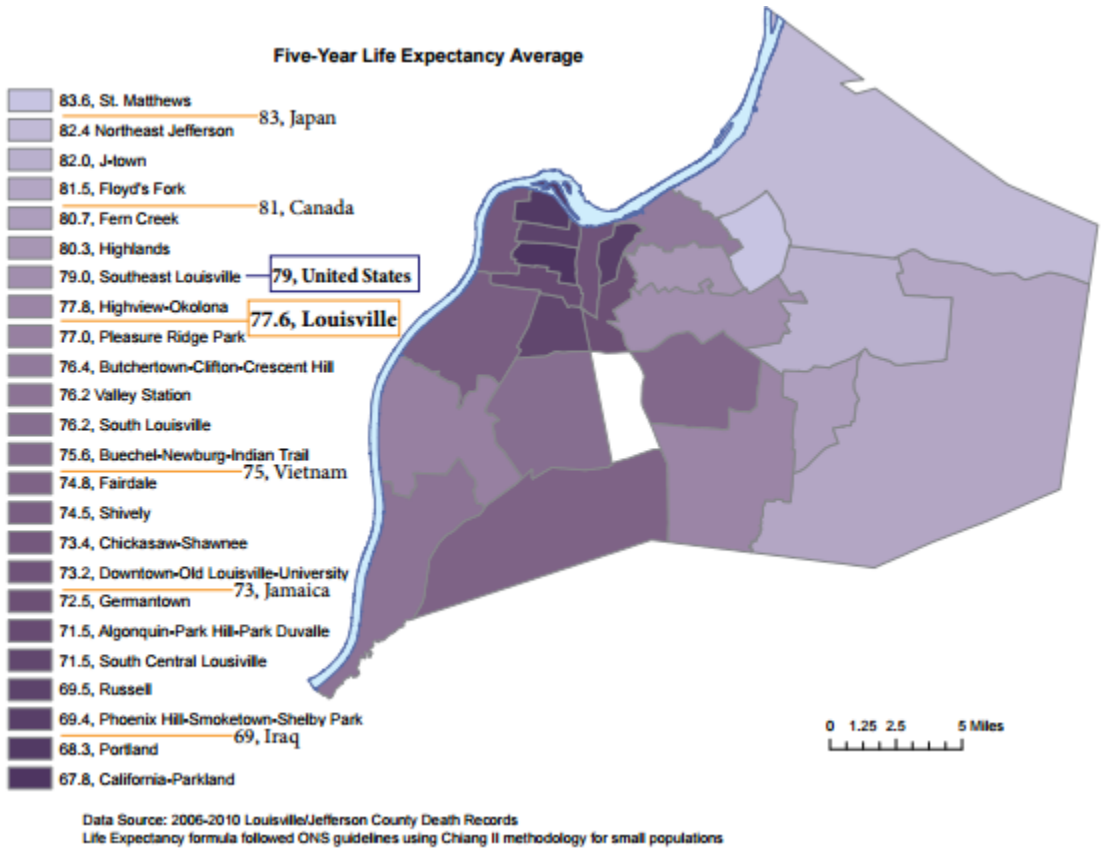


Figure 2. Disparities in Life Expectancy in Jefferson County, Kentucky from the Louisville Metro Government's 2014 Health Equity Report.

Convenient, comfortable, and quick forms of public transportation and the benefits of TOD can improve overall public health outcomes and reduce public health disparities through the reduction of emissions and traffic accidents, as well increased physical and mental health, accessibility of medical care, and affordability of transportation (Litman, 2010). Particularly important for Louisville, traffic fatality rates decline as public transit access increases in an area, and TOD communities experience a fraction of the traffic related fatalities as single-occupancy communities (Litman, 2010, 2014). Significant reductions in per passenger-mile pollution emissions are achieved through increasing connectivity of public transit to suburban areas and reductions of traffic congestion in the city center through bus rapid transit (Litman, 2010). Improved walkability and increased usage of public transit reduces sedentary lifestyles and improves overall community health (CDC, 2011; Litman, 2010). Zoning is a particular strategy that the city can use to encourage more equitable forms of development that encourage mixed housing and proper accommodation for alternative transit (Wheeler 2013). Equity, in terms of public health outcomes, is a particularly important dimension to consider in the development of socially sustainable public transit systems. Improving overall health outcomes and reducing health disparities for the poor and racial/ethnic minorities will ultimately make Louisville a stronger and healthier community.

Metrics

As shown in Table 1, potential metrics of public health impacts of transportation include: incidents of respiratory and cardiovascular disease, life expectancy, infant mortality rates, stress levels, and more.

(D) Identity and Heritage

Preservation and further development of historical and cultural heritage is regarded as a vital component of what must be sustained in social sustainability (Kates et al., 2015). Wheeler (2013) discusses the importance of maintaining cultural and historical identity and sense of place in building a sustainable community in conjunction with the development of a sustainable neighborhood plan in Portland, Oregon (see also, Smiley et al., 2014 for a case in Memphis, TN). Cultural and historic heritage is important to sustain in its own right (Kates et al., 2015). Wheeler (2013) also argues that it is important to develop a local identity, as it can serve as a springboard for future activities, and also serve to share that local heritage with both residents and visitors, boosting economic viability (see Economic Viability). In Wheeler's example he discusses the use of historic elements in unified signage that fits reflecting elements from iconic signage or things from the area, as well as highlighting significant geographic features of the region, and using art and informational signage that reflects cultural heritage from the area.

Identity is important in establishing a sense of place. Places with a strong identity make social cohesion easier, as having a strong sense of identity enhances community bonding (Uzzell, 2002). Areas with distinct heritage and character may also be easier to navigate, more welcoming, and more acceptable (Kaplan & Kaplan, 2003; Smiley et al., 2014).

TARC can play a significant role in helping to establish this identity by preserving cultural identity and heritage, and emphasizing the diversity of the city. For TARC to establish its' identity with local residents within the city, it must focus on building its place character through social cohesion and comfortability. This new identity should be re-built by rebranding TARC as not only representative of the entire community and Louisville's unique local history and culture, but as an enjoyable, safe, and positive riding experience in order to encourage new ridership, drawing from and incorporating local and regional culture in meaningful ways.

Establishing central hubs would be an incredible step in creating a sense of place for TARC in Louisville. These hubs can change how people picture TARC, help them understand TARC, and what makes TARC unique. Hubs also provide space and opportunity to highlight culturally important features of the region, outlets for culturally relevant business, and art installations of all kinds. If every bus travels through a hub at some point on its route, riders are able to build a picture of who TARC is and can engage with other riders, TARC employees, or informational kiosks for information, access to restrooms and seating, and water fountains in between transfers across town. Predictability is enhanced for novice riders, as they will always end up back at a hub even if they make an error in choosing bus routes.

In these cases, predictability, comfortability, historical and cultural preservation are indicators for establishing an identity as a dimension of social sustainability. Currently, this predictability is lacking through the many scattered routes without a central place to bring everything and everyone together. Information is fragmented and lacking in some areas. With

central hubs people can physically go there to collect information, speak with a TARC employee or local riders, and purchase passes with a sense of predictability, connectedness, social cohesion, and identity.

Metrics for Identity

In order to measure sense of identity, assessing perceptions of TARC and its infrastructure will be an important indicator of strength of identity, place character, and comfortability. Each of these has many components. For instance, place character could be assessed in terms of the appropriateness with regards to local culture and history or through the attractiveness and relevance of signage and artwork. Comfortability can be assessed in terms of atmosphere on buses, bus stops, or transit hubs or could be assessed through perceptions of efficiency, safety, and predictability.

(E) Safety and Security

Safety and security are vital dimensions of social sustainability. If a public transit user does not feel safe, either from injury resulting from a collision or from crime, that user is less likely to use and support public transit improvement efforts. This example can be illustrated by the perception that transit and transit oriented communities are unsafe, leading many automobile oriented communities like Louisville, KY to refuse to use nor support expansions of transit service and infrastructure. This perception however, is not true as recent research by Litman (2014) indicates that public transportation is a safe (low crash risk) and secure (low crime risk) mode of transit.

Crash Risk

Crash risk can be measure by multiple variables such as collisions, injuries, and/or fatalities. Litman (2014) shows that bus riders experience 0.11 deaths per billion passenger miles, light rail experiences 0.24, while car or light truck driver or passenger experience 7.28 deaths per billion passenger miles. This shows that an individual is roughly 66 times more likely to die as a result of a crash in a car than on a bus. Additionally, increases in transit ridership lead to proportionally larger reductions in crash rates (Litman, 2014). If you build it, they will come; the Transit Cooperative Research Program in 2008 found that people who live near transit oriented development (TOD) use their vehicle half as much as the regional average. So, when stations and transit oriented development are built, residents use more public transportation. Furthermore, cities with more than 50 annual transit trips per capita (Boston, Chicago, Seattle, Denver, etc.) have half the average traffic fatality rates than regions with less than 20 annual transit trips per capita (Litman, 2014). Additionally, transit oriented communities, as a result of public transit use and compactness, have about 1/5 the per capita traffic fatality rate compared to automobile oriented communities

Crime Risk

Some types of crime, such as theft, increase along with poverty rates and in many places public transit is perceived to be used by only those that cannot afford to drive. This perception

and connection leads many to fear public transit and believe that higher crime rates are associated with transit travel. However, the truth is that pro transit policies that increase ridership by responsible users, reduces overall crime (Litman, 2014). FBI crime statistics show that there are about 500 times more crime committed against motorists than transit users, transit travel has lower crime rates per passenger trip, mile, and hour, and the cost of transit crime is far lower than automobile crime. Additionally, research shows that transit oriented development reduces unemployment and poverty, thus reducing the type of crime associated with those attributes (Litman, 2014). TOD and Crime Prevention Through Environmental Design (CPTED) and the resulting increases of pedestrian activity and transit use, in addition to more compact and mixed use areas, also reduces total crime (Litman, 2014).

Public transportation is not only safer and more secure than automobile use, but policies such as transit oriented development lead to proportionally larger increases in safety and security. But, factors such as fear, media, and transit agencies failure to emphasize overall safety lead to a perception that transit is not safe nor secure and that TOD will bring increased crime. There is much that transit agencies can and should do to correct this perception such as: integrate information about safety and security of pro transit policies into communications, correct misconceptions, collect and distribute crash and crime data, and treat increased safety as a benefit when evaluating transit expansions and TODs (Litman, 2014). By taking the steps necessary to ensure that transit users are safe and secure and that transit oriented development projects are promoted to further increase safety and security, the safety and security dimension of social sustainability can be addressed.

Metrics

Metrics should reflect the presence of transit oriented development:

- Traffic statistics such as collisions, injuries, fatalities
- Collisions involving pedestrians or cyclists
- Crime statistics such as thefts, robberies, assaults, vandalisms, trespassing
- Ridership or annual transit trips per capita

(F) Economic Viability

Per their official website, TARC's mission is to explore and implement transportation opportunities that enhance the ***social, economic***, and environmental well being of the Greater Louisville community. These ideals are woven into the moral fabric of TARC itself. The company is a member of the Louisville Sustainability Council (LSC) and actively participates in the Sustainable Transportation Action Team (STAT), meaning they have a key stake in the sustainability of their service (TARC, 2015b). Here we look at how TARC can become more socially sustainable from an economic perspective.

Any sustainable practice must at its very core remain economically viable. Without a baseline of checks and balances, even the best businesses are sure to fail. However, within the social context, other layers must be included throughout the decision making process alongside the bottom line. This is especially true for an operating service such as TARC that must maintain financial stability but must also do so in a way that keeps their service affordable for

local riders. Economic progress must be listed alongside social well-being and environmental protection as one of the three main pillars to sustainable development (Kates et al., 2005).

Economic viability is defined as, the internalization of all external costs of transport (including subsidies) while respecting equity concerns, promoting appropriate research and development, considering economic benefits (e.g. increased employment from restructuring transportation, shareholder partnerships), and implementing new approaches to sustainable transportation (Gudmundsson et al., 2015). As we can see, economic viability is about much more than just the bottom line of any company. It must also incorporate the interests of all shareholders such as consumers, investors, and local residents that interact with and share the consequences of any business decisions.

Public transit funding is provided from a mix of federal, state, local, private and transit agency sources on top of directly generated revenues (Grigsby,2015). Recent trends indicate ridership on public transit is growing faster than funding levels and service provided at the national level (Grigsby, 2015). This puts TARC in a difficult situation as it must find a way to survive economically while remaining socially sustainable. There are no immediate future plans to expand any routes or services as the TARC system is supported by state and federal funds which has not been sufficient in keeping pace with cost increases (Toms, 2015).

For the year of 2014, TARC had more total operating expenses than revenues leading to a total deficit of more than $13 million (TARC, 2015b). Their current projection anticipates expenses rising at an estimated rate of 2 percent in 2015 (TARC, 2015b).

According to TARC's official budget report, operating funding is not keeping pace with expenses to cover the local share of federal grants and increasing costs for items such as paratransit, maintenance, health insurance and pensions. Their budget is further strained because the amount of federal funding for capital costs of operations relating to maintenance, tire leasing and contracting service, is also falling short of covering expenses (TARC, 2015b).

For TARC to be socially sustainable and economically viable, it must remain under budget while equitably servicing their rider base. This may currently seem like an uphill battle, but in this section we offer five suggestions that could increase revenue while remaining balanced within social sustainability guidelines.

Increased Tax Base

Currently, Louisville allocates much less tax income towards public transportation than many other metro cities (Schulz, 2014). We see this as an opportunity for change. The current .2% Occupation Tax provides the bulk of revenue which TARC estimated at $46 million for 2014 (TARC, 2015b). By getting local officials on board to move that mark closer to the 0.7-1.0% tax levels seen in other cities such as Dallas, Portland, and Austin; it would provide between $80-$100 million additional revenue annually (Schulz, 2014). This could even be spread around other avenues such as sales or payroll tax to make the increase less noticeable and easily absorbed into the community's budget. Similar tax hikes have been implemented in Colorado, Florida, and Washington D.C in the last 25 year (APTA, 2015). An increase of this

magnitude could greatly help offset the cost of building hub stations, adding more hybrid buses, revamping bus stop shelters, removing the operating deficit, and further growing TARC's social sustainability overall.

At the national level, a relatively large proportion of funding is generated from dedicated revenues, with the majority of these funds derived from sales taxes. Regional sales taxes dedicated to investment in public transportation have grown by 275 percent over the past 15 years but this trend hasn't occurred in Kentucky with little to no revenue for TARC coming in the form of sales taxes (APTA, 2015). We argue that the majority of potential to become economically viable lies in this area.

More Governmental Funding

As with taxes, Louisville also receives less governmental funding for public transportation than comparable cities (SOURCE). TARC is already focusing to secure increased operating and capital funding at the local, state and federal levels (TARC, 2015b). While this increased funding couldn't go towards operating revenue, it could provide relief for the operating deficit or assist capital improvements such as the new central hubs and technology.

In June 2012, the U.S. Congress approved legislation to reauthorize federal programs supporting public transportation and highways through September 2014, with continuing resolutions maintaining federal support. While funding is only slightly higher (2013 = $10.6 billion; 2015 = $10.7 billion), this represents an all time high in federal funding for public transportation (Grigsby, 2015).

Major federal commitments for new projects have grown at an exponential rate over the past two years. Typically projects are matched with state and local funding at approximately half of the total cost, however the proportion varies by project (APTA, 2015). With momentum building in this direction, now is the time to get government at all levels on board for TARC's vision of Louisville as a more sustainable transportation city. Starting with central hub stations is a great way to expand Louisville's public transit portfolio.

Two options to generate funding are grants and bonds. As the previous MAP-21 program expired last year, a new initiative called the Fixing America's Surface Transportation (FAST) Act was passed earlier this week to offer new funding the public transit agencies. This five year initiative will improve America's roads, bridges, public transit, and rail systems while reforming federal surface transportation programs (U.S. DOT, 2015). The portfolio includes a bus discretionary grant program and is an ideal choice for TARC's funding needs.

Another source of grant funding comes from the Transportation Investment Generating Economic Recovery (TIGER) plan on behalf of the U.S. Department of Transportation (DOT). The Louisville area already has two active projects funded by TIGER IV grants; one for the Transforming Dixie Highway Project and another to improve access into the Port of Indiana (U.S. DOT, 2015). Awards confirmed this year will provide nearly $500 million for 39 projects in 34 different states, so there is plenty of money available on an annual basis (U.S. DOT, 2015). The competition for TIGER funding is competitive nationwide and their awards

recognize projects that will advance key transportation goals such as safety, innovation, and opportunity. We argue that our central hub proposal is in line with these metrics and would be a compelling choice for a grant application.

The secondary option to source funding comes from bonds. They can be issued directly by a state or local government for repayment from the transit agency. Bonds provide front end capital that can be retired over time once project revenues are generated (APTA, 2015). Other cities have successfully used bonds to fund transportation activities such as expansion, bus stop improvements, and facility and technology upgrades.

An additional option that could generate revenue while radically changing Louisville's car culture is to impose a parking tariff. Similar strategies have been successful in cities such as London, San Francisco, Miami, and Pittsburgh to fund their public transit systems and other large metro projects. Current parking protocol favors excessive parking supply at minimal costs, which can lead to unwelcome consequences. These include higher development costs, reduced housing affordability, dispersed land use patterns (sprawl), and longer commutes which further contribute to existing downstream effects such as traffic congestion, roadway costs, crashes and carbon emissions (Litman, 2013). Louisville already has a street parking problem that clog up lanes that would be better utilized to improve the efficiency of public transit. Parking taxes would push cars off our main streets and generate revenue for TARC while making Louisville less car centric.

Economic Equity

The other side of the coin is maintaining a consistent price structure to ensure that riders can afford to use the service. For the bottom 20% of the income bracket, transportation takes up a disproportionate amount of expenses. These populations can spend up to 42% of their annual income on different modes of transport (Toms, 2015). With half of all TARC riders coming from households of income below $25,000, this fact is even more paramount (Toms, 2015).

For the second fiscal year in row, TARC did not raise fares or cut service. However, further projected operating budget deficits are likely to lead to adjustments at a time when demand for TARC services throughout the five county service area is increasing (TARC, 2015b). As lower income families make up a large portion of the rider base, improvements to the TARC service must not significantly affect the fare prices. Doing so could put stress on the already economically disadvantaged and potentially push them out of the rider market.

Neither of these consequences are socially sustainable as any riders gained from the attractiveness of proposed improvements are not likely to offset these losses. In doing so, any investments made in services would not be justified given a net loss of ridership. TARC needs to be creative in securing funding sources to offset the budget deficit so that they do not exclude the target market that makes up a large portion of their operating revenue.

Local Economic Improvement

Wheeler states that sustainable development must encompass three central economic principles: provide space to facilitate innovation in small businesses, offer central locations where a diversity of professionals can work and play, and build upon existing local culture and industry (Wheeler et al., 2013).

We argue that greater TARC access, for example, through various centers, could be a windfall for local businesses. Public transportation improvements and expansions have been well documented for their impacts on local economies. For example, Memphis, TN saw an increased spending in neighborhoods that gained access to the Shelby Farms Greenline bike lane system (Smiley et al., 2014). With expanded access to new parts of the city, eager cyclists took to the streets and found fresh places to eat, shop, and play and it was the local businesses that benefited most from this new patron base.

With greater access to the city attracting more riders, these new riders will be more likely to spend money along their routes on food, refreshments, goods, services, and entertainment. Much of this increased spending would correlate to the business districts that could sprout up around these hubs taking advantage of the attractive proximity. Nearly all other metro cities equipped with a public transit system have restaurants, shops, and service providers located just outside the major terminals offering easy access and reaping the rewards of a consistent customer base.

These central hubs would also open up new positions for employment that could further help stimulate the local economy. Ticket offices, more drivers, janitors, customer service representatives, security, potential food court personnel, and even surrounding businesses expanding their staff just to name a few. Given the current state of the economy, more jobs will only be a welcome sight to the local community.

Based on numerous studies investigating the impacts of public transit investment on local economics, we know that every dollar spent on public transportation generates $4 in economic returns (APTA, 2015). This correlation goes a long way in attracting local businesses to set up shop alongside hubs and create new mini-market districts.

As these locations carry expectations of local economic development, it would only be equitable to ensure these hubs are located in areas that have the greatest overall good for the most people. Locations need to be fair considering the demographics of both the city and TARC's ridership base. The amount of hubs and locations would be up to TARC but we suggest taking this context into consideration before finalizing their positioning.

Sponsored Hubs

Unless the system can get local companies to match other grants, the current service is not sustainable as the need for more buses and higher frequencies increase (Toms, 2015). To take advantage of the local economic boost central hubs could provide, local companies could purchase sponsorship rights to the new hubs gaining advertisement space and inviting riders to purchase their goods or services. This is a win-win situation for both the sponsors and TARC. Many of these businesses could be located near the hubs to allow easy access for riders

to become patrons. Potential discounts could even be offered to those with bus passes as a way to strengthen the alliance between all parties. Also, TARC itself could generate more funding through these partnerships that could help finance the cost of building these hubs, expanding their bus fleet, or even building their own marketing budget.

Partnerships like this are common in many industries and TARC itself already boasts +50 key partners in their budget (TARC, 2015). Offering ad space and unique sponsoring opportunities is an attractive way to add even more partners and become further entwined with the local identity of the city, county, and state.

Metrics

- Operating Budget
- Securing Additional Funding and Partnerships
- Equity of Cost and Benefits
- Local Economic Improvement

(G) Usability and Efficiency

Usability and efficiency of technological and built systems, such as transportation networks, play a large role in determining whether and how individuals use that technology (Popuri et al., 2011; Spears, Houston, & Boarnet, 2013). Usage patterns (e.g., public support) greatly determine overall sustainability of the system.

TARC can play a large role in improve usability and efficiency, with sufficient support from the wider community. For example, place character at bus stops specifically can help people identify TARC as a positive and friendly option for travel. These stops can be re-vamped with color and personality that points them to being part of TARC. People should be able to clearly recognize them, and understand the links to the surrounding areas. Comfortability will come from local residents having a connection with TARC. Naming routes after local characteristics such as bourbon trail, Derby lane, etc. is an example of establishing this identity. TARC can tie in Louisville's art scene, 'Keep Louisville WEIRD,' have local artists design buses or bus stops, or have bus stops sponsored by local businesses. Re-vamping bus stops with improved shelter, information screens, surveillance, charging stations, emergency alarms, or heat will all improve the comfortability of riders and their likelihood to start and continue riding.

SCENARIOS

In this section, we explore alternative scenarios that may describe different paths TARC and the city of Louisville may take. Exploring scenarios is an effective way of considering the costs and benefits associated with different courses of action in planning. We describe three possible scenarios, providing different perspectives on the topic: (1) An optimal scenario, in which the Vision for "A Connected, Equitable, and Popular Transportation City" is fully implemented over the long-term, (2) A more short-term and pragmatic scenario, in which the City embraces modest changes, and (3) Status Quo scenario, in which the City continues as it

currently is, without making significant and coherent investment in an integrated system of socially sustainable transportation upgrades.

Scenario 1: Optimal

The first scenario is our vision of sustainable transit in Louisville, a hub system of high quality multi-modal transit stations and transit oriented development. We anticipate that full implementation of our Vision, or something very close to it, would allow TARC and Louisville to realize social sustainability and experience a high level of social acceptance (e.g., APTA, 2011; Wheeler, 2009). The vision would dramatically alter our city, reducing the number of cars on the road while making public transportation readily available, accessible, and convenient. This makes our neighborhoods more safe and secure, our air cleaner and our overall levels of pollution lower, our residents healthier, our city more connected, economically viable, and equitable. As our city develops in this way and becomes more attractive and our universities continue to produce well educated and innovative citizens, those citizens will stay in Louisville, reversing brain-drain and flight, creating more businesses and jobs, and building greater economic opportunities for all (Smiley et al., 2014). Above this, Louisville will be known and seen as one of the region's premier cities attracting talent from across the country, further contributing to the greatness that is Louisville, Kentucky.

Changes of this kind will take considerable time and investment, carry risks, and require long-term commitment from multiple stakeholder groups, but will have the highest likelihood of ensuring Louisville's competitiveness in the world market, as well as its comprehensive well-being (e.g., economic viability, public health). Standards recommended in this scenario best match nationally recognized standards (e.g., APTA, 2011).

Scenario 2: Modest Changes

A second scenario involves TARC, and its partners throughout the metropolitan region, understanding and embracing modest, small changes to improve image, safety and security narrative, and improve service to existing riders. Under this scenario, TARC continues to look for creative sources of funding and looks to enhance bus service, improve stops, improve sidewalks, highlight and provide safety information and benefits, and continuing to provide service mainly to those that cannot afford to drive a car, rather than convince a large number of people to ride TARC instead of driving a car.

Without broader commitments, Louisville is very likely to continue to expand outward, because it must still rely primarily on single occupancy cars as the overwhelming source of transportation (see Wheeler, 2009). Thus, the current scenario may mitigate certain problems associated with transportation, but potentially weaken overall sustainability, representing a compromise solution. However, if incremental changes are used to build capacity for larger scale changes further in the future (e.g., integrated transportation hubs), then this approach could potentially be a path towards achieving the fuller Vision (such an approach will still require strong leadership and planning, as well as investment).

Scenario 3: Status Quo

The final scenario involves TARC and the city doing nothing to improve transit and sustainability beyond its current state: this scenario represents "business as usual," lacking substantial commitment to an overarching Vision, such as the one presented here. Louisville will continue to build more roads, highways, and parking lots as residents will rely on single occupancy vehicles in high numbers. The effects of high numbers of cars will continue to be felt and exaggerated in the forms of congestion, longer commute times, reduced quality of life, poor air quality and pollution, and the related unequitable health effects associated with pollution. These negative effects of car oriented city will continue to fragment the city both economically and culturally. Louisville will not be an attractive place for young, talented professionals to move and do business so Louisville will continue to suffer from brain drain and flight. Eventually, where a system remains unsustainable for a long enough period, social fragmentation and flight will lead to a severe decrease in economic output that may lead to an exodus similar to what has happened in Detroit, Michigan.

CONCLUSION

We have endeavored to provide a vision of a socially sustainable future for TARC, with associated dimensions and principles that make up social sustainability. The framework that we provided addresses the importance of acceptance, public participation, identity, equitable public health outcomes, safety, and economic viability as points of intervention that TARC can begin to analyze and leverage in order to work towards embodying the social dimensions of APTA's sustainability guidelines. We provided specific examples of social challenges to the long-term viability of public transit in Louisville, in order to explore the possibilities of improving Louisville through transit oriented development. Increasing public participation in the planning process, developing a strong sense of identity that reflects the community and TARC's comfortability, address the misperceptions about safety and security on public transit, and discuss possibilities to ensure economic viability through increasing public support and acceptance and engaging local communities in the planning process, and actively working with local, state, and regional governments and businesses.

TARC is actively balancing the demands of providing public transit to an enormous service area. While it may be difficult to effect sustainable changes in the current political climate in Louisville, it is important for TARC to partner with other sustainable development oriented community members and institutions, in order develop new strategies to increase public awareness of transit-related inequities and the benefits of riding public transit, improving service connectivity and navigability, as well as increasing public involvement in the transit planning process. We believe that it is possible for Louisville as city to become more sustainable, and an important factor of sustainability that we have to address as a community is transportation. TARC's role as the public transit authority in Louisville puts it in a particularly important position as a possible facilitator for economic, social and environmental change that will bring Louisville closer to a sustainable future.

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