

Future of Paratransit and Shared Mobility: Mapping Report



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THE FUTURE OF PARATRANSIT & SHARED MOBILITY: MAPPING REPORT

AUTHORS AND ACKNOWLEDGEMENTS

AUTHORS FROM ITDP

Sarah Cassius
Nour El Deeb
Mariam Sorour
Stanford Turner

CONTRIBUTORS TO THE REPORT

EDITING, REVIEW, AND ADDITIONAL SUPPORT WAS PROVIDED BY:

Holger Dalkmann
Aimee Gauthier
Christopher Kost
Jacob Mason

SUPPORTED BY

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ITDP

Contact

Institute for
Transportation &
Development Policy

9 East 19th Street, 7th Floor
New York, NY 10003

T: +1-212-629-8001
E: mobility@itdp.org
W: www.itdp.org

Table of Contents

| | |
|---|-----------|
| 1. Executive Summary | 4 |
| 2. Introduction | 7 |
| 3. Approach and Methodology | 8 |
| 4. State of Knowledge | 12 |
| 4.1. <i>Current Service Impacts</i> | 12 |
| 4.1.1. Access (Paratransit) | 13 |
| 4.1.2. Access (Shared Mobility) | 14 |
| 4.1.3. Equity (Paratransit) | 16 |
| 4.1.4. Equity (Shared Mobility) | 17 |
| 4.1.5. Employment (Paratransit) | 17 |
| 4.1.6. Employment (Shared Mobility) | 18 |
| 4.1.7. Safety | 19 |
| 4.1.8. Environment (Paratransit) | 20 |
| 4.1.9. Environment (Shared Mobility) | 20 |
| 4.2. <i>Transport Management</i> | 21 |
| 4.2.1. Governance | 21 |
| 4.2.1.1. North America & Latin America | 21 |
| 4.2.1.2. Europe | 23 |
| 4.2.1.3. Asia and the Pacific | 24 |
| 4.2.1.4. Africa & the Middle East | 26 |
| 4.2.2. Business Models | 28 |
| 4.2.3. Mobility Relationships & Management | 29 |
| 4.2.4. Data Management | 31 |
| 4.3. <i>Paratransit Improvement</i> | 33 |
| 4.3.1. Paratransit Integration | 33 |
| 4.3.2. Subsidies and Payments | 34 |
| 4.4. <i>Insights on Power, Politics, and Corruption</i> | 36 |
| 4.5. <i>COVID-19</i> | 37 |
| 4.6. <i>Consultations & Feedback</i> | 37 |
| 5. Findings | 39 |
| 6. Sources | 42 |
| Appendix A: Nicknames of mode types | 49 |
| Appendix B: Breakdown of reviewed documents by theme | 51 |
| Appendix C: Workshop Participants and Agenda | 54 |

1. Executive Summary

Paratransit (also known as informal or semiformal public transport) is a dominating force in urban transport systems today. In many parts of the world, primarily lower- and middle-income countries (LICs & MICs), paratransit provides crucial access to jobs, goods, and services (Phun and Yai, 2016). It also operates with little government oversight or regulation, which can lead to inadequate services, poor safety, adverse environmental impacts, poor working conditions, and severe inequity for users (Cervero, 2001).

Over the past three decades, there have been numerous efforts around the world to improve paratransit operations, using different approaches to enhance outcomes for passengers, workers, and owners (UITP, 2014; Salazar, 2015). The results have varied, providing valuable insights into the ways that effective business models, industry capacity, inclusive engagement methods, and institutional strengthening can contribute to a successful transformation of paratransit services.

Shared mobility provides convenient needs-based short-term access to shared vehicles. The term encompasses a variety of modes including car-sharing, bike-sharing, and micro-transit, which developed largely alongside new technologies (smartphones, GPS, electronic payments, etc.). Shared mobility has been a catalyst in altering the transportation landscape (Cohen & Shaheen, 2018). The services typically operate as private entities, and their emergence has led to increasing governmental responses (from regulatory action to partnerships), technology developments and disruption to traditional transport operations (Fingers & Audouin, 2019). Shared mobility has also led paratransit providers to adopt similar incremental improvements.

This report describes the current state of knowledge and ongoing activities in paratransit and shared mobility services, by mapping existing research and identifying specific gaps for further investigation. The study is structured around the following themes: Current Service Impacts, Transportation Management, and Paratransit Improvement.

The ITDP research team examined and studied more than 100 documents—including reports, articles, educational materials, background resources, and relevant literature (academic and grey). We performed a desktop literature search focused on academic literature using Google Scholar and university library databases. Our search for grey literature sources started with a review of the larger institutions (World Bank, ADB, ITF, WRI, TRB, etc.). We applied broad search terms and included variants of these terms and phrases. We also applied the snowball approach to relevant documents, examining the documents they cite and the documents that cite them.

The team conducted 13 consultations with subject-matter experts from around the world, including from ITDP regional offices. We also organized a virtual workshop related to paratransit and shared mobility services with academics and programmatic experts to assess and validate gaps in global knowledge on the topic.

Findings

The examination of the literature broadly highlighted a shortfall of research on the policy implications and impacts dedicated to shared mobility and paratransit, especially in LICs and MICs. We identified the following key findings and knowledge gaps:

| Themes | Key Findings | Gaps |
|---------------------------|---|--|
| Current Service Impacts | <ul style="list-style-type: none"> • Primary motivations for using paratransit: wait times & distance (high- & middle-income users); affordability (low-income users) • Congestion charging does not significantly affect ride-hailing ridership (shared mobility) • 74 percent of ride-hailing drivers in the US earn less than the minimum wage • Given a choice between paratransit and formal public transit, users prefer public transportation | <ul style="list-style-type: none"> • Quantitative studies • Shared mobility research outside of North America and ride-hailing • Environmental impacts beyond local carbon emissions • Impacts on driver wages and quality of life |
| Transportation Management | <ul style="list-style-type: none"> • Government investments into intermodal facilities & systems (parking near BRT, common ticketing systems) improves paratransit and overall network performance • Incremental or stepped approaches to paratransit improvement can upgrade conditions at less cost, time, risk and effort • On-demand public transportation services in HIC require a high level of government subsidies and are currently not sustainable for public agencies to deliver | <ul style="list-style-type: none"> • Government capacity for effective management of public transport systems • Allocation of risk between governments and operators • Regulatory responses to shared mobility in MICs and LICs. • Data collection and management, specifically around location for mapping (paratransit), security and privacy (shared mobility) • Business strategies used by operators |
| Paratransit Improvement | <ul style="list-style-type: none"> • Optimal for large buses to serve high-volume routes, smaller paratransit operations (vans and other vehicles) to serve low- | <ul style="list-style-type: none"> • Effective business models for paratransit service (e.g., net cost, gross cost, etc.) • Government support packages |

| | | |
|---|---|--|
| | <p>volume routes</p> <ul style="list-style-type: none"> ● Government subsidies for lower income households to access transit infrastructure improves accessibility and equity | <p>(payment schemes and subsidies) for paratransit operations</p> <ul style="list-style-type: none"> ● Role of paratransit operators and driver’s integration of paratransit with other transport modes (e.g., mass rapid transit systems), including fare structures and payment media |
| <p>Further Findings (includes consultations & workshop)</p> | <ul style="list-style-type: none"> ● Lack of a singular term for paratransit & shared mobility – variations in terminology can lead to different interpretations of services ● Communication between government and paratransit operators is a challenge ● Urban Freight (shared mobility) served a critical role during the Covid-19 pandemic, providing essential food, medicine and materials | <ul style="list-style-type: none"> ● Personal security when engaged in studying paratransit operations ● Long-term research commitments and sustained funding sources ● Different research approaches (anthropological, interdisciplinary, action, etc.) ● Lack of incentives for academia ● Institutions/programs/actors involved in respective topics without speaking to one another |

2. Introduction

Paratransit¹ or informal or semi-formal transit is often unscheduled, operating along quasi-fixed routes that may change frequently. It operates with little government oversight or regulation (Phun and Yai, 2016). Many terms are used to describe specific transport modes that fit this description (see Appendix A). In this paper we use the term paratransit to refer collectively to the services described above, irrespective of mode. In lower- and middle-income countries (LIC & MIC), paratransit provides users with mobility where no other transport services exist, providing crucial access to jobs, goods, and services. The lack of oversight for paratransit, however, often results in poorly-maintained vehicles, unsafe driver behavior, and fierce competition among operators for routes and passengers (UITP, 2014).

Over the past three decades, there have been numerous efforts around the world to improve paratransit operations, using different approaches to enhance outcomes for passengers, workers, and owners. In Bogotá, Colombia, for example, the government initiated legislative and executive actions to transition from informal bus operations to a more formal system, planned and managed by a government body (UITP, 2014). In Africa, several countries have pursued strategies for gradually transforming paratransit services. A common strategy is to establish paratransit operator associations to streamline channels of communication between government and the industry and to improve regulatory compliance (Behrens et al, 2016). In some cases, cities have worked with operators to develop formal operating companies, both in the context of bus rapid transit (BRT) systems (e.g., Cape Town, Johannesburg) and for city bus services (e.g., Kigali). Cities have also sought to achieve greater integration between formal services and paratransit systems (Salazar, 2015). Results from the range of transformation processes have varied, providing valuable insights into the ways that effective business models, industry capacity, inclusive engagement methods, and institutional strengthening can contribute to the successful transformation of paratransit services.

Shared mobility services have mushroomed as a result of new technologies and have proven to be a catalyst in changing transportation systems worldwide. Shared mobility is an umbrella term that encompasses various transportation modes, including car-sharing, bike-sharing, peer-to-peer ride-sharing, on-demand ride services, micro-transit, and other modes. It typically operates outside the purview of public transit and is often privately operated (Finger & Audouin, 2018). Examples of shared mobility, primarily in higher-income countries (HIC), include: ride-hailing companies like Uber, DiDi, and Gojek; transit companies that provide real-time information and updates on bus or train services; and the expansion of bike-share systems and shared e-scooters. The proliferation of services, technology, business uses, mode variations, and regulatory and

¹ In North America, “paratransit” has a different meaning—it is used for a service that supplements fixed-route mass transit by providing individualized rides to vulnerable populations (e.g., elderly or disabled people).

governance responses to the emergence of these businesses has led to incremental improvements in existing paratransit services to match and provide better service. Paratransit services may be further enhanced with innovations such as e-payments or digital maps to ensure that quality transit is delivered.

In this report, we investigate the current state of knowledge and ongoing research efforts in both paratransit and shared mobility, as defined above. First, we present our assessment methodology and process for exploring the connection between paratransit and shared mobility. We then present the state of knowledge on discrete topics within three specific themes (current service impacts, transportation management, and paratransit improvement), and three cross-cutting themes (power, politics, and corruption) and, finally, the impact of COVID-19 on both sectors (paratransit and shared mobility). Finally, we summarize our findings, identifying specific research gaps that could be addressed through further investigation.

3. Approach and Methodology

This study was carried out by conducting desktop research in the form of a literature review of the paratransit and shared mobility sectors globally. The research is focused on policy measures (encompassing regulatory strategies and governance approaches) that improve the sustainability of urban paratransit and shared mobility services. This report identifies key findings and potential areas for future research.

We have derived a definition of sustainable transport based on ITDP's High Volume Transport: State of Knowledge Final Report on Urban Transport (ITDP, 2019). Policy measures that improve the sustainability of urban paratransit and shared mobility services can involve regulations, infrastructure, and services that improve access to destinations in terms of time and cost. We chose to focus on the following aspects of sustainability:

- Access
- Safety
- Employment
- Equity
- Environmental impacts.

We explored discrete topics on the subject that are relevant for both paratransit and shared mobility operations and are applicable around the world. We believe there are many lessons to be learned from a range of experiences in different geographic locations and under varying economic conditions. The themes that we examined are structured as follows:

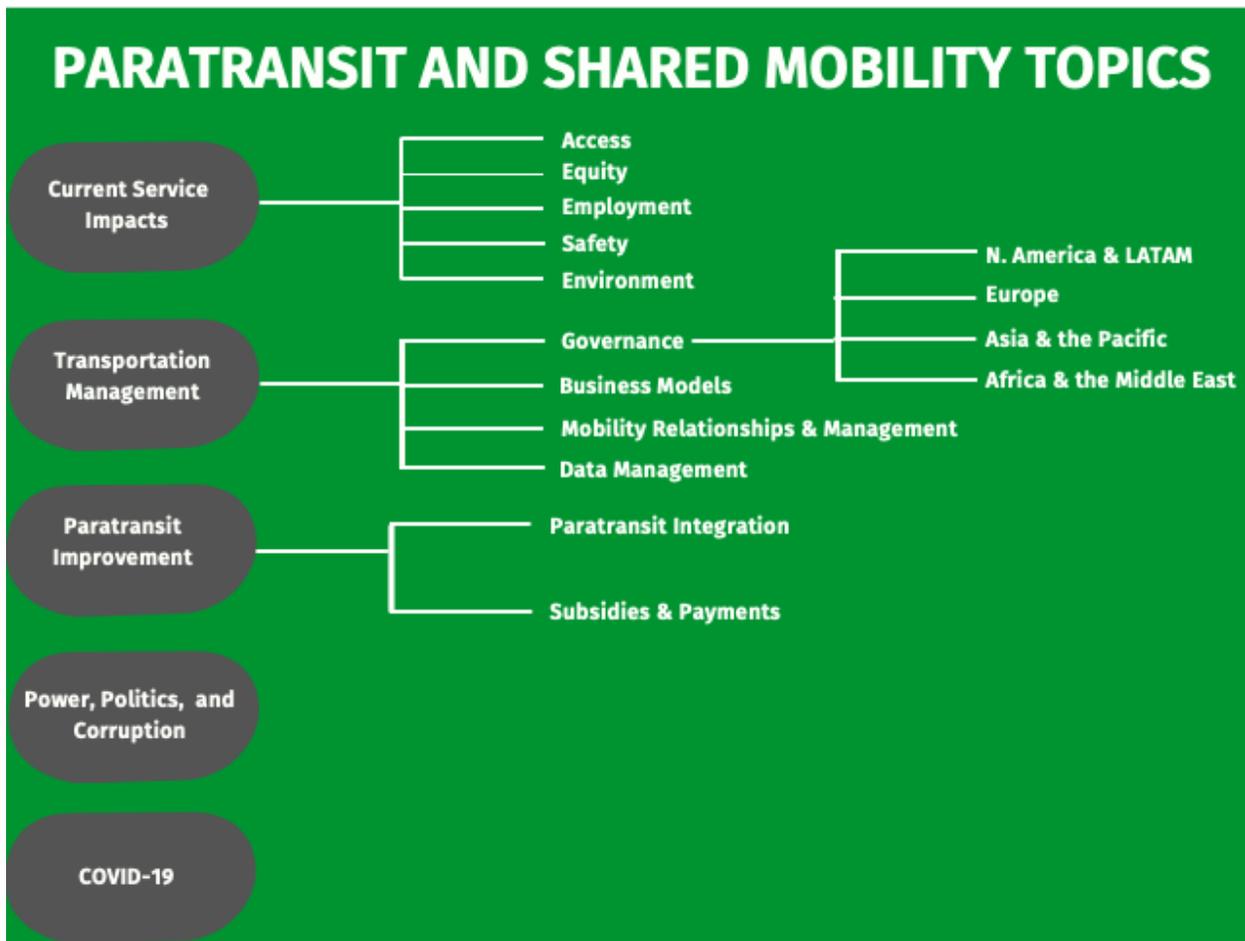


Figure 1

The unprecedented COVID-19 pandemic has affected transportation systems worldwide, including shared mobility and paratransit services, forcing them to adapt. In this report, ITDP has attempted to capture trends and potential long-term impacts that the pandemic may have on existing research areas, and to assess how future research may respond to these effects.

The ITDP project team examined and studied more than 100 documents related to paratransit and shared mobility services to assess and highlight global knowledge gaps on the topic (see Table 1 for the number of documents in each category). These included reports, articles, educational materials, background resources, and relevant literature (academic and grey) (for a breakdown of the number of documents by theme see Appendix B).

Table 1

| | North America & Latin America | Europe | Asia & the Pacific | Africa & the Middle East | Global |
|-----------------------|-------------------------------|--------|--------------------|--------------------------|--------|
| Academic Literature | 31 | 7 | 45 | 35 | 12 |
| Grey Literature | 23 | 2 | 3 | 5 | 8 |
| Peer-Reviewed Sources | 24 | 2 | 21 | 11 | 8 |

We performed a desktop literature search focused on academic literature using Google Scholar and university library databases. Our search for grey literature sources started with a review of the larger institutions (World Bank, ADB, ITF, WRI, TRB, etc.). We applied broad search terms and included variants of these terms and phrases. We also applied the snowball effect when key documents matched the research objectives.

During the course of the study, from April 2020 through October 2020, the team engaged in a number of interviews and consultations with transportation experts on the subject of paratransit and shared mobility. We conducted 13 interviews with experts and stakeholders from key organizations in Southeast Asia, South Asia, Latin America, North America, the Middle East, and Sub-Saharan Africa to hear their perspectives and understand the research gaps from their vantage points (see section 4.6). The interviews served to improve the team’s understanding of the practical challenges associated with each of the themes from practitioner perspectives.

Table 2

| Organizations Interviewed | Interviewees |
|---|---|
| ITDP Indonesia Regional Office | Faela Sufa; Gandrie Ramadhan, Insan Chairuasni, Ciptaghani Antasaputra, Made Vikannanda |
| ITDP Brazil Regional Office | Clarisse Linke |
| ITDP Mexico Regional Office | Gonzalo Carballo, Ceasar Muñoz |
| ITDP Africa Country Office | Christopher Kost |
| ITDP India Regional Office | Shreya Gadepalli, Sivasubramaniam Jayaraman, Vaishali Singh |
| ITDP India (Ranchi) Office | Rajendra Verma, Faraz Ahmad |
| BRT Centre of Excellence/University of Pretoria | Christo Venter |
| University of California – Davis | Jai Malik |
| Makeshift Mobility | Benjamin De La Peña |
| New Urban Mobility Alliance (NUMO) | Carlos Pardo |
| University of Cape Town | Roger Behrens |
| World Resource Institute (WRI) | Ben Welle, Hein Tun |
| Engicon/Ma'an Nasel | Hazem Zureiqat |

In addition to the interviews, the ITDP project team also held a virtual workshop with a number of the interviewees and other experts to discuss the preliminary findings from the literature review and consultations, as well as to explore the specific cross-cutting theme of power, politics, and corruption (see Appendix C).

The workshop was framed broadly around three main sessions: a presentation of initial findings, a discussion on *Power, Politics, and Corruption*, and a discussion on future research priorities. In light of the sensitive nature of the topic, and respecting the privacy of the contributors, the workshop instituted Chatham House rules to enable participants to speak freely without being limited by organizational positions or concerns, and to focus on building a deeper understanding of the issues and tease out potential research themes for further investigation (see section 4.4).

The consultations and the virtual workshop with the experts allowed the project team to validate the desktop study and provided crucial insights on the research.

4. State of Knowledge

In the following section, we present a summary of the state of knowledge—based on the results of global research—on the topics of paratransit and shared mobility. As described above, this is based on a literature review, a series of interviews, and a workshop. We describe what we know about the topics, the focus of current research, and how conclusive the evidence is. The state of knowledge is structured around the following themes: Current Service Impacts, Transportation Management, and Paratransit Improvement. This is followed by the cross-cutting themes of *Power, Politics, and Corruption*, COVID-19, and a presentation of feedback from the consultations and workshop.

4.1. Current Service Impacts

As described in the methodology section, we model the current service impacts around five discrete aspects of sustainability: Access, Equity, Employment, Safety, and Environmental impacts. As paratransit and shared mobility provide crucial services for transportation systems as a whole, we first must understand how they affect the people and places where they operate. This section assesses both services based on the framework described in the methodology section. The table below shows the number of studies reviewed, categorized by topic, service, and geographic region, to give a sense of the extent of research examined (see full table in Appendix B).

Table 3

| | | North America & Latin America | Europe | Asia & the Pacific | Africa & the Middle East | Global | Total |
|--------------------------------|-----------------|-------------------------------|--------|--------------------|--------------------------|--------|-----------|
| Current Service Impacts | | | | | | | 82 |
| Access | Paratransit | 1 | | 3 | 1 | | 5 |
| | Shared Mobility | 6 | 1 | 2 | 2 | | 11 |
| Equity | Paratransit | 1 | | 2 | 3 | 6 | 12 |
| | Shared Mobility | 8 | 1 | | | | 9 |
| Employment | Paratransit | | | 1 | 5 | 3 | 9 |
| | Shared Mobility | 5 | | | | 1 | 6 |
| Safety | Paratransit | 1 | | 4 | 1 | | 6 |
| | Shared Mobility | 3 | | 1 | | 1 | 5 |
| Environment | Paratransit | | | 3 | 1 | | 4 |
| | Shared Mobility | 5 | 1 | 4 | | 5 | 15 |

4.1.1. Access (Paratransit)

To understand the impact of paratransit and shared mobility services on access, we examine their impacts on both affordability and the time needed to reach destinations. The literature on paratransit access highlights the challenges that arise from lack of regulation, such as price

fluctuations and unpredictability. Through qualitative interviews and surveys, the researchers found that waiting time and distance to service were more important factors driving high- and middle-income users to choose paratransit, while low-income users' choice is driven by the prioritization of affordability (Basu, 2017; Tangphaisankun, 2009).

In Kenya, *matatu* bus fares are under private control and have seen substantial increases. More than half of the low-income industrial workers surveyed said that fare variations affect their decision to use a *matatu*. Ommeh found that the increase of *matatu* fares negatively impacts low-income workers' mobility and that those who cannot afford *matatu* fares opt to walk or cycle (Ommeh, 2012). A study of the mobility choices of slum residents in Kenya found that, despite strong connections to paratransit services (vans and *matatus*), the majority of survey participants could not afford motorized transport options and were often forced to walk (Salon & Gulyani, 2010). Surveys were also conducted in Visakhapatnam, India, to gain a comprehensive understanding of the socio-economic and travel-demand characteristics of informal-transit users. They found that the majority of paratransit users (83 percent) were middle- and high-income (Gadepalli et al., 2018). Paratransit users were found to experience shorter in-vehicle transit times and wait times than people using formal bus services. The researchers also found that 84 percent of paratransit trips were less than 10 minutes, indicating that the service is mainly used by riders whose origin and destination are located close to paratransit service areas.

One quantitative study that used an accessibility metric to compare paratransit services with a BRT corridor found that the lower prices, near-ubiquity of service, and flexibility of paratransit provided a higher level of access to job opportunities than the BRT network (Venter, 2016). Furthermore, research indicates that in Latin American cities, when existing paratransit modes are considered, the percentage of households with access to public transportation within a 10-minute walking radius increases from 8.2 percent to 21.8 percent (Tun et al., 2020). In a similar study in La Paz, Bolivia, researchers found that only 31.8 percent of households have access to formal transit, but 82.4 percent have access to semi-formal transit or paratransit.

There are several gaps in literature on the accessibility impacts of paratransit. The research mainly focuses on qualitative and local surveys of the perceptions and characteristics of users and lacks quantitative data that documents the cost of paratransit services. There is little information on how regulations and privatization change paratransit's accessibility or affordability in the global South. Additionally, there is far more research on affordability than on time impacts. However, the literature on paratransit accessibility is relatively balanced geographically.

4.1.2. Access (Shared Mobility)

The literature on shared mobility indicates that choices between various ride-hailing/ride-sharing modes are made based on potential time savings rather than affordability. In the Philippines,

survey results indicate that riders in Manila preferred GrabTaxi over regular taxi services because it had a shorter waiting time and could be paid for with an app (Napalang & Regidor, 2017). There is evidence that some shared mobility services reduce the time it takes to reach destinations. An overview of a pilot electric scooter program in Chicago found that the time savings per trip varied by neighborhood but on average were about three to four minutes (Smith, 2020). The same study reported that the scooters made 12.3 percent more jobs accessible within a 30-minute commute time and over 20 percent within a one-hour commute. In comparison, the scooters were 24 percent quicker than walking and 29 percent faster than using public transit.

There have been a variety of public- and private-sector efforts to promote shared mobility services or establish policies to improve access to existing services. In Delhi, for example, the government suspended surge pricing to preserve affordability (Paronda, 2016). Ride-hail drivers, however, have been known to avoid picking up users in low-income neighborhoods or slums, reducing access for more vulnerable populations (Kodransky & Lewenstein, 2014). In the United States, some insurance networks (such as the Alliance for Nonprofits for Insurance) specialize in covering shared mobility systems and have been used in Denver and San Francisco to facilitate widespread access (Kodransky & Lewenstein, 2014). In Brazil, homegrown services such as JaUbra have filled gaps in formal transit and larger ride-hailing services for users who live on the periphery of the city and lack access to regular mobility options (Oviedo & Perez-Jaramillo, 2020).

In North America, regulators have successfully maintained affordability through regulation. For example, one study found that to improve congestion, cities like New York imposed caps on the time spent without passengers during peak hours and levied a charge for all for-hire vehicle trips that passed-through the congestion zones (Li et al., 2020). The city passed the cruising cap into law; however, it was later struck down by the New York State court system. To protect drivers, New York officials also implemented a minimum per-trip wage. Similarly, Chicago officials imposed a congestion tax and San Francisco officials imposed an excise tax on ride-hailing trips. Li et al. have found that congestion charges do not significantly affect ride-hail ridership, and that the increased tax burden falls on the ride-hailing platform rather than on passengers and drivers. In the New York case, the passenger travel cost only increases by 0.8 percent, with no change in the driver wage but a 35 percent decrease in platform profit (*ibid.*).

The existing literature on the accessibility of shared mobility focuses on HICs, specifically North America, with limited literature in Southeast Asia. Access literature proved to be solutions-oriented and conducted through surveys using both qualitative and quantitative methods. Future research on shared mobility could focus on LICs and specific policies that deal with affordability issues and access in lower-income areas of cities.

4.1.3. Equity (Paratransit)

To assess equity, we examined the impacts of paratransit and shared mobility on the health, safety, access, and employment of vulnerable populations (e.g., lower-income, women, and minorities). The existing literature describes vulnerable populations that face issues of safety, affordability, and other obstacles to using paratransit operations, while still noting the importance of these services in place of formal transportation options. For example, one study examining access in underserved communities found that residents either faced such severe limitations in terms of transport options that they rarely traveled or that they were forced to spend as much as 35 percent of their income on commuting (Venter et al., 2019). A survey-based study focused on the impacts of paratransit operations in Africa found that paratransit drivers work on average 20 hours a day and that approximately 22 percent of *danfo* drivers are partially blind, with 99 percent suffering from hypertension. This suggests that users face unsafe traveling conditions and highlights the exacting demands on drivers (Agbiboa, 2020).

The literature on issues of equity and gender within paratransit illuminates the disproportionate burden placed on women, and suggests that prioritizing gender in project implementation has failed to achieve the intended goals. For example, a survey of mobility choices in slum areas of Kenya noted that while all residents faced challenges affording paratransit, it was even more challenging for women and children to afford access to paratransit services (Salon & Gulyani, 2010). In a quantitative study of gender transport poverty in Pakistan, researchers found that men not only have greater access to different mode types on paratransit services but are also allocated more physical space when using them (Iqbal et al., 2020). A World Bank Study examined the impacts of its transportation projects (some of which involved planning around informal operators) globally around issues of gender (such as empowerment, inclusion, and security) in project implementation. The report found that “gender mainstreaming”—the practice of consistently assessing policies, programs and planned actions from a gender perspective—into transport projects had some positive results, such as providing more data on the issue and having more women participate in the planning process. It also noted that the majority of the World Bank-funded projects examined in the study failed to achieve their defined targets on gender equity and that further commitments during project conception were needed to provide more gender-balanced results during implementation (WBG, 2004).

The research on paratransit and equity assessed conditions for multiple vulnerable populations (lower-income, operators, women). Much of the literature, largely built on survey information, documents the challenges faced by poorer socio-economic groups related to affordability and access. The bulk of the research was conducted by academic institutions and based in African countries. There is a significant gap in paratransit equity research in Latin America, the Middle East, and South Asia. More information is also needed on the long-term effects of paratransit improvement on equity.

4.1.4. Equity (Shared Mobility)

There is considerable research tied to issues of equity and shared mobility services. Several papers look at the impacts of access and affordability of shared mobility services on users and vulnerable populations. The authors of a paper focused on developing an equity and climate action plan for Los Angeles around shared mobility services noted that these services often require a credit or bank card, Internet access, or a smartphone (NRDC, 2018). The study highlights that eight percent of the U.S. population—largely low-income families—lacks bank accounts and that almost 36 percent do not own a smartphone, with that number increasing to 50 percent for people earning less than USD \$30,000 a year and 73 percent for senior citizens (NRDC, 2018). Another study examines emerging technologies such as electric vehicles and shared mobility and whether they provide cost-efficient alternatives to traditional modes. The study finds that the beneficiaries of new technologies are those who can afford the additional cost of alternative modes of transport (Guo et al., 2020). This would indicate that the benefits of these services are not distributed equitably to vulnerable populations, who may lack the financial resources and access to necessary technology to utilize the services.

Other research indicates that shared mobility operations can have negative impacts on wait time for vulnerable populations. Yet the same studies also find that shared mobility tends to provide more coverage and equitable options for lower-income populations, racial and ethnic minorities, and women than would otherwise exist (Kodrinsky, 2014; Brown, 2018; Brown, 2019).

Researchers have found that ride-hailing services do improve overall mobility in megacities such as Manila, Jakarta, and Bangkok, but they warn that the growth of these services may exacerbate congestion and inequality in large cities, the latter because large percentages of the population do not have bank accounts or access to credit (Schechtner & Hanson, 2017).

For shared mobility, the vast majority of research examines the U.S. and Europe and looks at the issues of affordability and inequity of shared mobility services. Based on the literature we were able to find, more information is needed from other parts of the world, specifically Latin America, Africa, and Asia. Additionally, there is a lack of research on the equity impacts of non-ride-hailing services such as bike-share and shared scooters in locations outside of North America and Europe.

4.1.5. Employment (Paratransit)

Labor is a crucial component of paratransit operations. The literature on employment shows the significant role that paratransit drivers, operators, and users play in urban transport systems and the local environment (Agbibo, 2016). In Africa, paratransit often serves as the de facto public transit system, while also providing employment opportunities for residents. For example, in Lagos, Nigeria, the *okada* taxi industry provides almost 500,000 jobs, including positions for drivers, mechanics, spare-part dealers, and rental company staff (Agbibo, 2020). Paratransit systems provide employment opportunities for poor and lower-skilled workers (Cervero &

Golub, 2007), but the research also highlights the uncertainty of these positions (Agbibo, 2016). In his book *Taken for a Ride*, Mateo Rizzo examines the transient nature of the paratransit workforce and finds that employees have very little bargaining power, as the market has an oversupply of available low-skill labor (Rizzo, 2017).

Several studies examine workforce implications of paratransit related to the integration of formal operations like BRT. Research by Venter assessed the potential impacts of BRT initiatives in providing access to employment opportunities in Johannesburg, South Africa, and found that BRT alone could not match the pervasiveness and low price of paratransit services (Venter, 2016). Another study, which also examined the Rea Vaya BRT project in Johannesburg, found that with a proper employment framework agreement, paratransit employees who transitioned to work for the bus-operating company saw significant increases in annual earnings compared to their previous occupation (McCaul & Ntuli, 2011). This suggests that formalization efforts can improve employment conditions for public transport employees.

The literature on employment and paratransit is mostly academic (survey data and interviews) and is mainly qualitative, with a focus on drivers' quality of life. The research covers various transit modes, and the bulk of the research is based in Africa, with the majority being conducted by local researchers. There are significant geographical gaps. More research is needed on the labor market connection and impacts of paratransit, especially in Latin America and Asia.

4.1.6. Employment (Shared Mobility)

The research literature on shared mobility regarding employment focuses on potential job opportunities and the effects that services are having on the labor market and workers. Cohen and Shaheen find that shared mobility services could create new employment opportunities and generate revenue from private automobiles, which are typically not being utilized to their full potential (Cohen & Shaheen, 2018). Conversely, a study analyzing ride-hailing drivers' revenue, expenses, and taxes in the U.S. finds that the median profit from driving is USD \$3.37 an hour before taxes and that 74 percent of drivers earn less than the minimum wage in their state (Zoepl et al., 2018). The research does show that the ride-for-hire market has accelerated with the growth of ride-hailing. It also indicates that the low barriers to entry for drivers have allowed for increased access to employment opportunities and provide drivers with more wage transparency (NASEM, 2016). This has had a secondary effect of driving wages down for the for-hire vehicle drivers, as there are more drivers competing for jobs, especially in large metropolitan markets (Wang & Smart, 2020).

The research on shared mobility and employment is heavily skewed toward ride-hailing and is concentrated in the U.S. The papers, which are mainly academic publications, examine the economic impacts of shared mobility services from an employee's perspective and provide more insights into the cost, wages, advantages and disadvantages of working in this service sector.

Some studies highlight the financial challenges associated with working for shared mobility companies. There is still a significant need for additional research on the subject, especially from other parts of the world than the U.S. More information is needed on employment conditions in other forms of shared mobility services, as all of the literature we found examined ride-hailing applications like Uber and Lyft.

4.1.7. Safety

Although paratransit services are essential, the literature shows that operators often use poorly-maintained and unroadworthy vehicles and drive unsafely, with fierce competition between rival operators for specific routes and passengers (UTIP, 2014). Poorly-regulated paratransit has led to hyper competition and its by-products—fatigued drivers, vehicle overloading, and roadway violations—all of which increase collision rates (Corvero, 2001). In the case of informal transit, research conducted from the perspective of users commonly places the blame on the absence of regulation, law enforcement, and police (Joewono & Kubota, 2005). Conversely, research conducted from the drivers’ perspective tends to blame the condition of paratransit vehicles and socio-economic factors (Boateng, 2020).

Some of the literature touches on potential solutions for making paratransit and shared mobility safer. One study provides an overview of the Safe Travel to School program, which was created in South Africa to make minibus taxis safer for child passengers. The program aims to ensure safety by monitoring driver performance through devices installed in the vehicles. Drivers also undergo health and training courses, and they are rewarded quarterly for good performance. Researchers found that this program has increased driving performance and improved passengers’ perception of the safety of the services (Janmohammed et al., 2019). Similarly, ride-hailing researchers have suggested that the introduction of mandatory dashboard cameras, a watchdog network, a distress alarm in the app, keeping vehicle cabin lights on at night, better displays of company logos on cars, and passenger insurance add-ons improve safety (Chadhury et al., 2018). Researchers studying paratransit in Asia posited that emerging paratransit modes, like electric vehicles, seem promising in that they have come with new designs and better safety standards, which tend to reduce collisions in traffic (Phun & Yai, 2016). The researchers encourage governments to use incentives to promote the development of better infrastructure to support new paratransit initiatives, such as electric paratransit modes. Researchers in India and Cambodia interviewed users about their perceptions of the safety of rickshaws and motorcycle taxis. In both cases, the results showed that users of the service found the vehicle structure and dynamics unsafe and that they would switch to formal public transportation modes when given the option (Phun et al., 2018; Priye & Manoj, 2020).

The literature on paratransit safety was mostly focused on Southeast Asia, with a few case studies in South Africa and West Africa. We were unable to locate any research on paratransit systems’ safety or shared mobility in Latin America, which has many ride-sharing options and

informal transit systems. The safety literature also mainly focuses on users' perceptions, with little quantitative assessment of traffic collisions, injuries, or deaths. The literature surrounding safety for ride-hailing and shared mobility was concentrated in HICs.

4.1.8. Environment (Paratransit)

The literature on paratransit reveals the polluting nature of paratransit infrastructure. In the Philippines, jeepneys that use re-conditioned diesel engines have caused an increase in greenhouse-gas emissions and poor air quality, which has been addressed by governmental initiatives to replace machines and promote electric vehicles (Regidor et al., 2009). Similarly, in Asian LICs and MICs, research shows that paratransit causes air pollution because of the often poorly maintained, second-hand imported vehicles used (Phun, 2016). In another study, using estimates based on survey data, researchers found that erratic driving behavior often results in low fuel efficiency and high greenhouse-gas emissions. However, the authors of the study note that the data used to inform the study is inadequate. To improve the data, they recommend collecting both self-reported distance and fuel consumption data, optimizing survey administration, and promoting climate finance mechanisms that will help to lower the costs of and barriers to gathering data (Nugroho & Zusman, 2015).

In contrast, some paratransit modes may have lower environmental impacts than road-based modes. In a city in Côte d'Ivoire, ferries, known as *pinasses*, provide a vital method of travel for low-income users. Pinasses are wooden, diesel-driven ferry lines that connect an inner-city peninsula to other parts of the city. The ferries are produced from locally-available wood and recycled tarpaulin (Kabran & Eguavoén, 2019). The wooden ferries are largely biodegradable, which helps reduce potential garbage, and they require limited energy and new construction materials to build. To reduce the ferries' negative environmental impacts further, Kabran and Eguavoén suggest that the diesel engines be replaced by a technology that utilizes a more sustainable energy resource, such as solar-powered motors.

The majority of environmental research on paratransit that we identified was conducted in Southeast Asia. We found few published results on the environmental impacts of paratransit in Latin America and Africa. Further, most paratransit research looks strictly at direct pollution from vehicles and does not consider the impacts resulting from vehicle construction, fuel extraction, and fuel processing.

4.1.9. Environment (Shared Mobility)

The literature surrounding environmental impacts and shared mobility focuses on whether or not ride-hailing reduces greenhouse-gas emissions and congestion, and if it diverts users away from public transportation or private vehicles. Research from the U.S. indicates that ride-sharing increases traffic congestion, while other research, especially from Asia, shows significant environmental benefits from ride-sharing. Ride-sharing in China has been found to reduce total

kilometers driven by 24 percent (Jalali et al., 2017; Lee et al., 2019). In Beijing, researchers found that government policies that shorten pickup times and increase vehicle occupancies are the most beneficial with respect to reducing congestion and avoiding greenhouse-gas emissions (Xue et al., 2018).

Using U.S. public transportation ridership data, the degree of traffic congestion, and individual transportation mode choice survey data, researchers found that Uber has enabled users and walkers to travel more conveniently, which is reflected in an increase in traffic congestion (Lee et al., 2019). On the other hand, private car owners were found to use a combination of Uber and public transit rather than their private automobile. The researchers concluded that Uber's entry into a city increases traffic and reduces demand for public transportation. This is particularly true in highly compact cities, where the proportion of public transit users and walkers is higher than that of drivers. A study by Lime about its own scooters found that 34 percent of users in Portland, Oregon and 38 percent in St. Louis, Missouri replaced their most recent trip by car with a scooter trip (Wachunas, 2019). The same study found that in Paris nearly 60 percent of users chose an electric scooter over a personal vehicle. In St. Louis, Lime scooter users were estimated to have prevented 96 metric tons of carbon emissions since the service began.

Shared mobility research is extremely concentrated in North America, Europe, and East Asia, and the research findings are inconclusive. Most of the leaders and policymakers interviewed in this study stated that they wanted to wait to see how the effects of ride-hailing manifested before implementing policy regulations to control them.

4.2. Transport Management

As transportation systems continue to evolve, the distinctions between paratransit and shared mobility are becoming less clear. Both services are experiencing changes in the way they are regulated, operated, and adapting to new technologies. In this section, we examine the intersections of both services under the themes of Governance, Business Models, Mobility Relationships and Management, and Data Management.

4.2.1. Governance

The landscape for paratransit and shared mobility is shifting rapidly, and governments themselves have responded in various ways. In this section we investigate how regulations and governance approaches impact fleet deployment, infrastructure investment, oversight, paratransit planning, and other transportation management operations.

4.2.1.1. North America & Latin America

North America and Latin America contain some of the biggest markets for shared mobility in the world. Sources that investigate the governance of shared mobility in North America and Latin

America found that regulatory outcomes are a function of two factors: ride-hailing companies' government relations strategy and the degree to which local governments perceive Uber, and other ride-hailing companies, as complementary or a threat to the existing market. Spicer et al. found that most cities responded to Uber with a ban or sanction, but in all 10 North American cities that were examined, Uber achieved legal status either through confrontation that forced leaders to pursue regulatory reform or through open collaboration with regulatory authorities (Spicer et al., 2018). Through a discourse network analysis and a case study on the regulation of Uber in New York, Seidl found that the success or failure of Uber regulation depends on the ability of actors to mobilize broad coalitions, that narratives affect the composition of these coalitions, and that those platform companies have both political strength and vulnerability (Seidl, 2020). These findings imply that regulations are contested continuously, and as ride-hailing companies show a disregard for existing laws, regulatory bodies will have to find ways to balance policy goals with public perception and compliance. The second implication is that the political conditions underlying regulatory responses are not set in stone and that ideas and stories are powerful tools to justify policies.

A study commissioned by the City of Vancouver looked into approaches to regulate the ride-hailing industry (Ngo, 2015). Ngo recommends creating a new regulatory category for ride-hailing, mandating municipal background checks and licenses, closed-circuit cameras, mandatory driving-training programs and exams, wheelchair-accessible service, and fuel-efficiency standards, data reporting, and data-sharing.

Andrew Bond has focused on how Uber has won fights against the taxi industry and regulators, and how local governments should respond to Uber and rapid technological advances as a whole (Bond, 2015). In San Francisco, the birthplace of Uber, the San Francisco Municipal Transportation Agency (SFMTA), argued that regulation is important to maintaining a strong taxi industry. SFMTA recommends that San Francisco lower the medallion re-transfer fee by 20 percent and waive the USD \$500 ramp taxi medallion use fee and renewal fees. Bond argues that Uber's impact on San Francisco was convincing the agency designed to advocate for the taxi industry that its regulations were actually a hindrance to the taxi industry. Uber's biggest impact in New York was drastically lowering the price and value of taxi medallions: In 2010 a taxi medallion cost more than USD \$1 million. In 2013 the average price was USD \$872,000 (Bond, 2015). Of the three cities examined, Washington, D.C. took the most free-market approach toward Uber's arrival, at least partly because the district does not restrict the number of taxis it allows to operate. D.C. passed the Vehicle-for-Hire Innovation Act of 2014, which required Uber drivers to undergo background checks going back seven years and complete annual safety inspections. The act also, reaffirmed insurance requirements that the company already met. Uber praised the bill, while taxi drivers argued that it was too lenient (Bond, 2015).

There is a large gap in research on paratransit governance and regulation in the Americas. One study examines private bus operators in Mexico. The authors hypothesize that the short-term political gain from formalizing existing bus operators will negatively affect performance, reduce leverage to regulate the emerging system, increase operating costs, and limit the ability to integrate the system in the future (Flores-Dewey & Zegras, 2012). By examining four BRT corridors in Mexico City, they found that compared to basic formalization of existing bus operators, the introduction of BRT had more potential to transition away from informal paratransit systems and “empower the state as a regulator.” Mexico was the first Latin American country to formally regulate and legalize Uber. Brazil is Uber’s second-largest market, and Uber has largely taken over the United States’ shared-mobility market. Because of this, the studies that have been conducted revolve specifically around the regulation and governance of Uber. Additionally, many cities in the United States have focused their initial regulation efforts primarily on the protection of taxi drivers. This priority seems to slowly be shifting toward the protection of drivers and shared-mobility users.

A recent study conducted by the Inter-American Development Bank (IDB) begins to address the research gap in the Americas, by examining paratransit services in Latin America and the influence that bus reform efforts have had on shared mobility in the region. The researchers, using a variety of research methods (a literature review, interviews, and case studies), analyzed the pros and cons of different regulations and technologies to impact paratransit operations. They posit that paratransit operations are viable and should be considered a legitimate form of public transport in Latin America (Tun et al., 2020).

4.2.1.2. Europe

The research publications we found examine policy measures that are being implemented in Europe to regulate ride-hailing and paratransit services. One particular piece of research contains a comparative analysis of Uber’s introduction and operation methods in Germany and Sweden (Thelen, 2018). The paper focuses on the different conflicts that Uber provoked on its arrival in both countries. In Germany, after Uber introduced multiple services and became involved in numerous legal battles with local taxis companies, the Frankfurt state court banned Uber, ending the company’s German operations. Thelen found that the company was perceived as a threat to the public interest because it took over the local transportation markets through unfair competition and disregard for the rules. In the same study, the policy impacts of a law passed in Sweden in 1990 that deregulated the taxi market in the country and the subsequent government response are examined. The law enabled Uber’s rollout in Sweden, but the tax authorities had no record of Uber’s earnings for assessing tax liability. To address this, the government passed stopgap legislation that requires all for-hire drivers, including Uber drivers, to report to a government office to empty their taxi meters. This neither banished nor accommodated Uber; rather, it adjusted the existing regulation to fit the Swedish framework. This new law allowed Uber to continue operating while protecting fair competition by making the company abide by tax policies and licensing requirements (Thelen, 2018).

In another paper, Moscholidou and Pangbourne discuss how state intervention is crucial for mitigating risks and guiding smart mobility services, such as ride-hailing and car-sharing, in a way that contributes to sustainable transport goals (Moscholidou & Pangbourne, 2020). The researchers found that regulations in London hold ride-hailing providers accountable for their impacts on the urban environment and help local governments to achieve their strategic smart mobility goals. They identified three key features of successful regulations for guiding smart mobility: (1) regulations should be directed to the different types of smart mobility; (2) regulations should clearly state providers' responsibilities and what happens in case of non-compliance; and (3) regulations should align long-term goals with smart mobility services. The researchers found that regulations in London that were thought to have been successful prior to the emergence of smart mobility services are now coming into question, as they do not apply to the types of services offered. Transport for London introduced strategy guidelines that set out the city's expectations from smart mobility providers and recommended future actions. Finally, the researchers found that compliance is not mandatory, but that smart mobility providers are responsible for some of their impacts on the city through other regulations that are not directly linked to smart mobility (*ibid.*).

There are significant gaps in the literature on ride-hailing services and governance in Europe. Since paratransit is not a major component of the transport system in Europe, there is little research about its governance. Much of the existing research examines ride-hailing service providers like Uber and their interactions with the traditional for-hire taxi industry. Future investigation and research focused on the way platform business models interact with different labor regimes in Europe would provide a useful addition to the literature. Additional analysis could compare regulatory attempts to promote environmental sustainability and the impact that ride-hailing operations have on urban transportation systems.

4.2.1.3. Asia and the Pacific

The research on the governance of paratransit operations in Asia and the Pacific is fairly robust in comparison with other parts of the world. Phun and Yai conducted a literature review of paratransit research in LIC and MIC Asian countries in 2016 that explored approximately 30 reports, a number of which touched on governance and its implications for paratransit systems (Phun & Yai, 2016). Phun and Yai highlight research by Satiennam and Loo (Satiennam et al., 2006; Loo, 2007) that shows that investments by government agencies into parking facilities tied to BRT can help link well-organized paratransit feeders and improve overall network performance. Other research refutes the efficacy of the strategy of prohibiting paratransit services. A social impact assessment of the policy implications of prohibiting and removing jeepneys in favor of BRT found that such a policy would lead to increased unemployment for drivers and reduced mobility options for public transit users (WB, 2012). Some researchers have explored the impact of auto-rickshaws on promoting sustainable transport within the framework

of India's National Urban Transport Policy (NUTP), and have determined that the government should think of it more as a door-to-door service that will help reduce private motor vehicle usage while improving the larger transportation system (Mani et al., 2012). Others examined the government's role in introducing electric vehicle policy to promote the successful implementation of electric paratransit in Nepal, called Safa Tempos (Roy et al., 2001, KEVA, 2003). The researchers noted that the policy served as a catalyst for increasing electrification within the country.

A series of studies compares road-based urban transport in six Asian countries from a governance and legal framework. Researchers found that most of the paratransit modes are operating lawfully. One of these studies identified the development of intermodal facilities and systems—like bus stations in Indonesia and a common ticketing system program in Thailand—as important governmental investments that make the system more efficient (Muromachi et al., 2015). Another study from the series examines the governance structure of road-based transport in each of the six countries and identifies the particular levels at which oversight of paratransit systems is observed. The researchers found that half of the countries exercised some regulatory action on paratransit services. These included subsidies (free rides for students and elderly people, low-interest loans for vehicle purchases), taxes (registration, ownership, fuel consumption), and other incentives (eco-vehicle discount, diesel fuel discount, free land rental for parking and maintenance) (Wicaksono et al., 2015).

In another article, researchers examined the adoption of technology, particularly ride-hailing apps (RHAs), by paratransit operators in Cambodia. The researchers reviewed the regulatory environment for for-hire-vehicles and RHAs and examined the legality of these applications that they use, within the context of other nearby Asian countries. Based on the review, the authors recommend a flexible approach to regulating RHA systems, as it may help to increase the number of trips for paratransit operators and increase driver revenue—especially in contexts where there are limited alternative transit modes (Phun, Masui & Yai, 2018).

Another study, conducted by ITDP on public transportation reform in Jakarta, Indonesia, examines and provides policy guidelines for cities on integrating paratransit with BRT. The report, which highlights the steps taken by the city government when developing its BRT system, Transjakarta, notes the operational policies (business plan, infrastructure & fleet investments, regulations, and transition model) that have improved the quality of public transportation in the city. The paper reinforces the importance of such actions, by providing a real-world examination of the payment-integration system, Jaklingko, which the BRT system invested in and provided to mini- and micro-bus paratransit operators (known as *Angkot*) that shared routes with the BRT system (ITDP, 2020).

The paratransit literature on governance in Asia and the Pacific is quite significant. While much of the research concentrates on Southeast Asia, the research examines multiple modes as they relate to policy oversight and different governmental mechanisms. The research mostly consists of academic papers, with a mix of qualitative and quantitative studies examining the implications of regulatory approaches in the sector. The current gaps are geographical, with more research needed on paratransit services within South and Central Asia. The research also fails to examine paratransit and its relationship with weaker institutions and the operational issues of integration within the formal system.

The literature on shared mobility services and governance is more limited. The publications that do exist examine different transport modes, such as dockless bike-sharing schemes, the potential integration of Mobility as a Service (MaaS) into formal public transportation systems, and the effect that increasing growth in the use of shared mobility applications is having on urban transport systems in large Asian cities. A study conducted by Schechtner and Hanson examines the legal framework for ride-hailing in the Philippines and notes that these services are not used by the majority of the population, because large portions of Filipinos lack access to banking services (Schechtner & Hanson, 2017).

The lack of literature on shared mobility operations and their interactions with the regulatory environment highlights a crucial gap in research. While there are a variety of studies on different mode types and services, more research is needed to further investigate the impacts of policy actions on shared mobility services, especially their effects on the social and environmental fabric of Asia. Additionally, the literature on areas outside of Southeast Asia would help supplement the research on the sector.

4.2.1.4. Africa & the Middle East

This research examined policy measures that are being implemented in Sub-Saharan Africa to regulate paratransit and identified research gaps in governance approaches to transport management operations.

A series of studies examine the case study of Addis Ababa and digital minibuses (on-demand bus services) that could contribute to the city's sustainable mobility goals. The researchers suggest that operators need to address several technical and behavioral hurdles that impact the digital minibus service (ITDP & LSE, 2020). These obstacles include: smartphone adoption and use, Internet connectivity issues, and electronic payment penetration. The researchers suggest that the government needs to play a role in route design for digital minibuses, to ensure the appropriate supply of service and that new services are compatible with existing operations. Data-sharing by digital minibus operators with the government is crucial, as transport planning requires accurate data on current travel patterns, including passenger, vehicle, and safety-related data.

Another potential intervention for achieving a city's sustainable mobility goals is using pricing to favor larger, more sustainable vehicles. Larger vehicles allow multiple passengers to share the same vehicle, reducing the number of vehicles on the road and negative environmental impacts. This can be done by introducing clear incentives for high-occupancy shared modes. In the short term, parking fees could be instituted to manage the use of motor vehicles. In the long term, congestion pricing could be used to incentivize shorter and shared trips (ITDP & LSE, 2020).

In Nigeria, one study (Shittu, 2014) posits a new approach for paratransit regulation, moving from overt institutional controls to more covert participation and supervision. Historically, paratransit operators have been very resistant to regulatory action. A less forceful approach may lead to greater acceptance of oversight. Shittu believes that Intelligent Transportation System (ITS) technology, which may be less invasive and more efficient, can be a component in efforts to address traffic management issues, transport service deployment, and operator registration and licensing, to obtain optimal benefits from the informal transport sector with government investment (*ibid.*).

In the Digital Matatus project in Nairobi, researchers conducted an analysis applying a bottom-up approach to study the use of common technologies such as cellphones to enhance existing informal services. Through a low-cost, practical approach, researchers produced the first-ever public transit map and supporting data set for the *matatu* system. This was provided for free to the public and enhanced the services for citizens. Most of the time smart cities are built based on a top-down approach that does not adequately address the local context. The bottom-up approach of the Digital Matatus project was a success because it was adapted to local conditions (Williams et al., 2015). The next step in the research was to link the data to open-data architecture, such as General Transit Feed Specification (GTFS). This effort faced many obstacles but stimulated additional research (*ibid.*). On-the-ground, experts in the field state that the Digital Matatus project had a moderate influence on government policy. When consulted about strategies for regulating paratransit, the main agency responsible for regulating *matatu* operations (NTSA) was unaware of the Digital Matatus map and data. Experts also stated that, as of today, the Kenyan government has not taken ownership of the map. Furthermore, the government now has a plan to ban *matatus* from the central business district entirely (Wangari, 2020).

Chris Plano of the University of Cape Town has found that both incremental and stepped approaches have the potential to produce successful outcomes in paratransit mechanisms and structure in Cape Town and Nairobi. Incremental reforms include infrastructure investment, operational incentives, and vehicle quality/safety interventions. Incremental reforms leave the existing organization structure and individualized operations of paratransit intact. The stepped approach involves changing the organizational structure by creating cooperatives, as well as a shift to collectivized operations (Plano, 2019). In Cape Town, phase 1 of the BRT system was launched to replace the paratransit system with a trunk and feeder system. The process involved

organizing operators into vehicle-operating companies, with owners converted to shareholders while drivers were trained to operate new BRT buses (Plano, 2019). The compensation for operators to withdraw their operating licenses required major public funding, on top of the investment in the transition to, and operational subsidies for, the BRT. The City of Cape Town indicated that paratransit will continue as a reformed, hybrid network of trunk feeders to scheduled BRT services.

Plano also explored the transport management company (TMC) model and its potential for paratransit service improvement in Nairobi. In this case study, the first step in the stepped approach was to employ collective fleet management. Operations managers ensure that buses are rotated between more and less profitable routes, so that franchises can earn equally. Owners have no role in routing or scheduling (Plano, 2019). Companies also manage crews by scheduling them to work four to five days a week and exchange or recommend drivers. Drivers can also switch owners or vehicles if they are unhappy with their current position. Companies set up trackers in vehicles to manage performance and control routes (Plano, 2019). Incremental and stepped approaches are intended to build the paratransit industry's trust in the regulator and to pave the way for additional reforms.

There is very little research on ride-hailing and governance as it relates to Africa and the Middle East, though there have been a number of efforts to collect public transport data in the region. The bulk of existing research is largely academic, and most information is focused on route planning and data-sharing. There are also significant gaps in research on the various transportation modes operating in the region, such as ride-hailing. It is important to note that public transport transformation models in Africa have been only sparsely studied. One example of such research is a case study of the Kigali, where the city government managed to consolidate paratransit operators into a larger company while helping them purchase new buses and switch to 100-percent-electronic fare collection. Potential future research opportunities include exploring different types of data-sharing strategies that governments and agencies could deploy, as these play a crucial role in route design.

4.2.2. Business Models

Increases in the adoption of smartphones, data availability and analysis, and private capital have enabled shared mobility services to develop and innovate in several ways. Different business and operations models have been adopted as a result. Much of the information that we have found regarding business models has been published by governments making efforts to develop or facilitate transport services. Understanding transport business models is very important for creating effective regulations, but this information is often proprietary. Businesses are strongly opposed to sharing such sensitive information, for fear of reducing their ability to compete with other companies. As for paratransit, there is little evidence on the business models adopted. This

limits our understanding of developments in the industry. This section focuses on research exploring paratransit business approaches.

In a research paper published by ITDP and the London School of Economics (LSE) Cities initiative, researchers examine a number of case studies addressing the business operations and models deployed by ride-hailing offerings globally (ITDP & LSE, 2020). In Helsinki, Finland, a public model was followed, where Kutsuplus was developed as one of the world's first fully-automated, demand-responsive public transport systems. The researchers found that the implementation costs were borne by the government, with the system designed to pick up passengers moving in roughly the same direction in the same vehicle. As the system was established by the government, regulatory constraints were not an obstacle, but the system required a steady flow of subsidies. Due to the high level of subsidies, the services were not sustainable, and the Helsinki Regional Transport Authority (HSL) Board agreed to terminate the service.

Another case study from the report examined the impact of a private operating model in Nairobi. The bus aggregator Swvl, headquartered in Cairo, created a smartphone app through which customers can book trips. In Kenya, the company partnered with vehicle owners to bring vehicles onto the platform. However, this initiative faced regulatory uncertainty and opposition from some sectors of the *matatu* (paratransit) industry. As a result, services provided by Swvl and a similar bus aggregator were temporarily suspended. To comply with regulations, Swvl now partners with vehicle owners who are already part of registered Savings and Credit Co-operatives (SACCOs), the entities licensed to operate *matatus* in Kenya.

The German city of Hamburg adopted a hybrid model when it launched a ride-hailing service named Moia in 2019, employing electric vans (six-seaters) manufactured by the Volkswagen Group. Users can book a ride by entering their origin and destination locations in a smartphone app. Hamburger Hochbahn, a public transit operator in Hamburg, welcomed the launch of Moia and introduced a strategy to address consumer needs and increase ridership by fostering multiple options, such as shared bicycles, e-scooters, and electric ride-sharing options.

There are large gaps in the existing literature on the business operations of ride-hailing services. Much of the research that is available looks at North America, Europe, and parts of Africa. There is a lack of information on Asia and Latin America. Additional research on the operational models of different modes, and further investigation into micro-mobility operations (such as bicycles and e-scooters) are also needed.

4.2.3. Mobility Relationships & Management

This section addresses research that attempts to provide a better understanding of the relationship between paratransit and ride-hailing service innovations, technology and management. From the

point of view of access, equity, and both effective and inclusive planning, the pervasive lack of both data collection and information regarding the value of paratransit systems as a crucial part of transportation are concerns (Klopp & Cavoli, 2019). Klopp and Cavoli argue that inclusive and collaborative planning can help make minibuses more relevant in planning and spur conversations on multi-modal integration, minibus upgrading, and passenger information. This planning would also help to create low-emission, accessible, safe, and high-quality public transport in Africa. By comparing two grassroots mapping projects of minibus systems in Nairobi (Digital Matatus) and Maputo (Mapa dos Chapas), the researchers found that limited access to location data about the systems (routes, stops, etc.) is an initial barrier to better integration. However, access to geolocation data (via cellphones) is increasing, and this has created new opportunities to map minibus systems (Klopp & Cavoli, 2019). The researchers found that this information has facilitated better dialogue and understanding between the operators and the city regarding the delivery and impacts of paratransit and shared mobility services.

In another study, researchers examined the global way that ride-hailing services affect existing transportation systems and found that there are different “trajectories” for certain types of urban environments (Hannon et al., 2016). The researchers posit that cities naturally move toward specific technologies that address their specific needs. The paper provides examples, indicating that cities like Delhi or Mexico City, which are already dense and have major issues with congestion and air quality, tend to shift toward cleaner mobility solutions (such as electrification) and prioritize ride-hailing and public transit investments. Cities that have different commuting patterns and are sprawling, like Los Angeles, are well suited to dedicating road space for electric and automated vehicles. Cities with denser populations, like Singapore and Hong Kong, focus on first mile/last mile by developing mobile applications to augment their well-built public transport systems and incorporating ride-hailing services to deliver improved transport options via apps (Hannon et al., 2016).

A study by Phun, Masui, and Yai (see section 3.1 Current Service Impacts) indicates that the adoption of technology like RHAs has trickled down to paratransit operations (Phun et al., 2018). The researchers found that technology has improved service delivery and benefited drivers and passengers. Researchers studying the Digital Matatus project in Nairobi concluded that using common, low-cost, and practical technology like cellphones can enhance existing informal services (Williams et al., 2015).

There is still very limited research on the relationship between innovation and paratransit and ride-hailing services. The reports that we identified were a mixture of academic and grey literature publications that were fairly balanced geographically. More research could be devoted to examining the types of partnerships that the government and the private sector are engaging in to promote sustainable service delivery. Specific research areas could examine the impacts that

ride-hailing is having on achieving environmental goals of reducing greenhouse-gas emissions or improving air quality. Further investigation into the different types of ride-hailing offerings, especially micro-mobility to improve first mile/last mile connectivity, should also be considered.

Participants in the ITDP workshop (see Section 4.4) on paratransit and shared mobility discussed the need for more literature on self-regulation among paratransit associations and operators, and on the challenges of extracting insights into how they work. Other research suggestions included the role of the private sector in helping to drive market reorganization and what approaches could emerge from that.

4.2.4. Data Management

Much of the research on data management in the realm of paratransit and shared mobility focuses on the potential for a third party to deal with data collection and storage. One shared mobility study examined a privacy-preserving service that computes meeting points for ride-sharing users so that the users, rather than the company or driver, are in control of their own location data (Aïvodji et al., 2016). It proposes a “decentralized architecture” that guarantees security and privacy without sacrificing usability. The service computes mutually-convenient meeting points for drivers and shared-mobility users and has built a prototype for implementation.

Other research proposes that there is a dichotomy between data that is too sensitive to be open for analysis, and the need for data to measure success and make improvements on current systems. This results in a system that prioritizes data as private proprietary information, which undermines efforts to make systems more fair, transparent, and accessible (Young et al., 2019). Access to this data is necessary for government agencies to enforce policies, for researchers to evaluate it, and for the public to hold companies accountable. The authors discuss the challenge of balancing these ideas while also preserving individual privacy and competitiveness between agencies. They also argue that a third-party public-private data trust should be created to balance these competing interests.

The authors of a third study argue similarly that mobility data-sharing can encounter problems of both over- and under-sharing, and that the ideal approach is the middle ground, where data are shared in specific contexts but managed by a trusted third party that can capture the benefits of data-sharing while minimizing the risks (D’Agostino et al., 2019). This approach necessitates voluntary agreements from mobility providers, clear data-sharing requirements for ride-hailing, the establishment of publicly-held big-data repositories monitored by third parties, and the leveraging of innovative land-use and transportation planning tools.

In Nairobi, the Digital Matatus project set out to collect data and translate it into the general transit feed specification (GTFS) format. The project succeeded in identifying how GTFS can be

adapted to other informal systems, that there is a demand from local communities for comprehensive data on paratransit, that the release of open data in the GTFS standard format can help to encourage the development of transportation applications, and that including the transit community during data development can create a community of users and create trust in the data (Williams et al., 2015).

Some literature delves into issues of privacy. In particular, Uber was found to use extremely precise and invasive geolocation technology that tracks the location of users even after the conclusion of a ride, which is longer than Uber's privacy policy indicates (Hayes et al., 2018). Uber argues that while this may pose a privacy concern for users, it has the potential to help digital forensics investigators. Similarly, researchers examined three ride-hailing applications in Indonesia and found that although the companies have adopted the core principles of data protection, they cannot ensure that shared information is erased from the vendor's device after a transaction (Ghandi et al., 2018). They also are not forthcoming about their compliance with national regulations. In a London lawsuit from Uber drivers against Uber, the company was able to use the drivers' personal data as legal ammunition against them in court (Holder, 2019). The drivers then launched data requests in a lawsuit claiming protection under the European Union's General Data Protection Regulation, which gives E.U. citizens the right to request all personal data that a platform retains about them. Holder argues that this data can help inform transportation and labor policy-making, such as in New York, where it helped policymakers craft the U.S.'s first ride-hail minimum wage and a cap on ride-hail licenses. Vinayaga-Sureshkanth et al. have outlined the possible dangers of the exploitation of bike-share and shared e-scooter systems by outlining the privacy and security challenges of dockless battery-powered e-scooters. They argue that a hacker could drain the e-scooter battery, eavesdrop through unencrypted applications, manipulate or disrupt the services, manipulate the rider's GPS location, and share user data (Vinayaga-Sureshkanth et al., 2020).

Although the majority of available literature on data management related to shared mobility and paratransit highlights the need for increased privacy protections, some studies address the potential benefits of the data collection. For example, Ford, Uber, and Lyft joined forces in an attempt to reduce traffic congestion and emissions and created SharedStreets, which combined public and private data so that cities can make more informed decisions on the implementation of mobility services operating in 30 cities globally (Edelstein, 2018). However, as has been seen with the emergence of systems like Lyft Shuttle, which is functionally a bus, there are severe repercussions from exchanging passenger data and money between the public and private sectors. This limits the ability of transportation policymakers to be informed by passenger data and to optimize planning to serve residents. Edelstein underlines the importance of collecting transportation data to better serve policies and planning, and how this is now in the hands of private companies.

The literature that we have reviewed centered on North America for shared mobility and Africa for paratransit data management. The largest gaps in data management research regard tested and evaluated examples of good data management. There are examples in cases of African paratransit that indicate how data management can benefit the development of infrastructure and mapping of roads. However, they do not delve into personal security and privacy issues. Additionally, the studies on shared mobility focus on data management challenges. The only proposed solution that we found in the literature involved management by a third party, but there are not many publications that provide examples of this in practice.

4.3. Paratransit Improvement

Many cities around the world are struggling to provide affordable and efficient transport to their citizens. Efforts to improve paratransit systems generally fall under the terms “reform,” “integration,” or “formalization,” and they often happen in conjunction with the development of BRT corridors around the paratransit service. This section explores notable examples of paratransit integration, as well as efforts to subsidize paratransit services to support improvements.

4.3.1. Paratransit Integration

The literature on paratransit integration includes case studies from around the world. In one study, researchers examined the Mexico City government’s attempt to improve the public transport system by formalizing existing paratransit modes (McCaul & Ntuli, 2011). The city focused on two points (fleet renewal and developing BRT) to deliver these improvements. The researchers found that the formalization process for operators along the BRT corridor proved to be relatively smooth. The government worked with existing BRT operators to form a BRT operating company and negotiated an operating contract. Conversely, the study indicates that in Santiago, Chile, the city attempted to replace the old bus network with a new comprehensive public bus scheme called Transantiago, implementing the transition to the new system (including a new smart-card payment system) on a single day. This approach proved unrealistic: passengers shifted to underground metro services where possible, as the new services were hindered by the absence of dedicated bus lanes and poor management (*ibid.*).

Considerable research has been carried out addressing the development of the Rea Vaya BRT system in Johannesburg, which involved the integration of paratransit operators from the minibus system in a more iterative process. One study looks at the 14 months of negotiations that led to a transformative shift of the paratransit minibus taxi industry (McCaul et al., 2011). Other research analyzes the Rea Vaya line development in comparison with a BRT corridor in Cape Town and the long-term feasibility and risk factors to government-led reform efforts in South Africa (Schalekamp & Behrens, 2013). Another study compares this effort with those typically done in Latin America and found that the Rea Vaya system may not be sustainable as it struggles to

cover its operating costs from farebox revenue (Scorcia & Munoz-Raskin, 2019).

Phun & Yai (2016) have performed research on paratransit modernization, and discuss four key factors necessary to sustain paratransit systems in Asian developing countries: (1) improvements in the quality of service, (2) integration with mass transit systems, (3) promotion of electric paratransit modes, and (4) government support. The common view regarding integration is that it is optimal for larger buses to serve high-volume routes and for smaller buses to serve low-volume routes (Mistro & Behrens, 2015).

Considerable research has been performed examining paratransit improvement efforts related to BRT deployment. There is a blend of academic and grey literature on the subject, and the research examines cases in every region. There are still significant gaps, however. Further research is needed that investigates the impact of newly-introduced mass transit systems, or mass transit expansion, on the paratransit sector. Such research would help governments and responsible authorities to determine how to maximize the effectiveness of the different systems. Additionally, more studies need to examine different approaches to paratransit transformation and forms of gradual reform that policymakers should consider for moving the industry toward greater consolidation, to improve overall system integration and efficiency. Moreover, further analysis that investigates the fare structure of paratransit services and how it can be linked to fares in formal systems would be valuable. While these approaches can improve the paratransit industry, studies are needed that focus on the characteristics of cities and paratransit operations. These will differ by location, with important policy implications. In this context, a review of the size of the paratransit market would need to be conducted in each city, as market size plays a role in determining which paratransit system is most suitable: every city has different characteristics, such as population size and modal share of public transport.

4.3.2. Subsidies and Payments

This section explores the research that has been performed on subsidies and payment for paratransit services. In LICs and MICs, relatively few municipalities have established funding structures to subsidize public transport. Governments frequently have under-developed taxation regimes and face a host of competing demands on public funding resources, from basic sanitation to health care to education. Where public transport subsidies do exist, governments have often directed them toward state-owned bus enterprises rather than privately-operated paratransit services (Muromachi et al., 2015).

There is literature on the different subsidy approaches that governments take with respect to public transportation offerings. Some cities have chosen a hybrid model, where a portion of the revenue risk is absorbed by the government and a portion is placed on operators. For example, in Santiago, Chile, under the contract negotiated with Transantiago bus operators in 2011, approximately 30 percent of the revenue risk lies with the government (Gómez-Lobo & Briones, 2013).

Some cities have offered indirect financial support to the paratransit sector by facilitating the purchase of new vehicles. In Dakar, Senegal, the government financed the cost of 505 new vehicles under a project that began in 2005 (Kumar & Diou, 2010). The government provided a credit covering 75 percent of the cost of the new vehicles, supported in turn by a USD \$15.9 million World Bank concessional loan, while operators provided a 25 percent down payment. The bus renewal program has enhanced the transport service quality in the city along project corridors and provided operators with below market rates on new vehicle purchases. Quantitative information on the financial return on investment is not available.

Another study found that in 2016, the Mozambique government purchased some 400 buses and leased them to paratransit operators, who were required to form cooperatives to participate in the scheme (Schalekamp, 2020). The initiative has laid the groundwork for the professionalization and restructuring of paratransit operations in a relatively short time frame. In Manila, the Government of the Philippines partnered with three banks to finance the purchase of modern buses to replace the traditional jeepneys (Kaenzig et al., 2019). By 2019, the program had supported the introduction of 500 new vehicles on 30 routes. Operators received a loan at a six percent interest rate and a subsidy of USD \$1,560, and were required to make a five percent down payment. The fleet renewal was paired with a mandate for operators to join cooperatives in order to obtain route franchises. The deployment of larger-capacity vehicles resulted in increased commercial revenues. The study results show that in modernized operations, considering the increased investment requirements, the return-on-investment rates usually surpass those of conventional operations over the 15-year life of the purchased vehicle.

Targeted subsidies for groups such as students and elderly and poor people, whose access to public transportation is limited due to poverty, is another, indirect, form of financing. The government of Bogotá has introduced a pro-poor public transport subsidy program to alleviate the financial strain on poor households of accessing the city's public transit infrastructure. Results of a study of this case show that for those with access to the subsidy, accessibility and equity improved (Guzman & Oviedo, 2018). In Egypt, the Ministry of Social Solidarity and the Ministry of Transport recently announced that senior citizens over 70 years of age can use public transport modes, including trains, buses, and metro, for free. Citizens over 60 years old will receive a 50 percent discount on all transportation fees (Al-Youm, 2020).

In response to the COVID-19 pandemic, governments have called for paratransit operators to adopt physical-distancing measures and to follow other public health protocols. However, in many cases these new requirements have been implemented as unfunded mandates, and operators pass the costs on to customers in the form of higher fares. Lower occupancy rates have spurred calls for subsidies for the paratransit sector in a number of countries, including Ghana, Kenya, Nigeria, South Africa, Zambia, and Zimbabwe (Akinsanmi, 2020; King, 2020; Koech, 2020; Nettey, 2020). In Dakar, Senegal, the government has provided financial assistance but only to formal operators (Diouf et al., 2020). The same report finds that the city of Kumasi, Ghana, created a stimulus fund for paratransit associations and workers.

Sources of finance for public transport subsidies vary. Sometimes the funding is provided by earmarking a portion of fuel taxation, parking revenues, congestion charges, property taxation, or advertising revenues (Wicaksono et al., 2015; Ardila-Gomez & Ortégón-Sánchez, 2015). In other cases, such as the United Kingdom and the United States, it is sourced from general revenue or national multi-year funded initiatives (Ardila-Gomez & Ortégón-Sánchez, 2015).

There is substantial research on subsidies associated with paratransit operations in LICs and MICs. Most of the research has been performed in academic studies, and it is fairly geographically balanced with all regions represented. There is an opportunity for additional research to investigate political decision-making regarding funding and subsequent impact assessments of providing payments or subsidies to paratransit operations, in order to determine the viability of, and identify potential improvements to, service delivery.

4.4. Insights on Power, Politics, and Corruption

Power, politics, and corruption frame nearly all aspects of paratransit and shared mobility. Various actors shape policy creation, policy implementation, and public opinion. Such influence was a recurring underlying theme in both our interviews and our workshop—especially as it pertained to paratransit operations. For instance, in India, experts interviewed mentioned that there are several unions that informally manage the routes in the city of Ranchi. Experts observed that the government finds it difficult to communicate and engage with these unions, as it considers them to operate as “mafias.” A similar issue was found in Rio de Janeiro, Brazil, where vans are operated by “militias” and compete directly with the public service. Local agencies there find it difficult to engage with them officially, as they have significant political power.

In both the workshop and the interviews, much of the discussion regarding power, politics, and corruption involved identifying knowledge gaps on the topic. In the workshop, participants agreed that a historical examination of colonialism and power associated with neo-liberal economics is missing, and that such research would be important to provide context for understanding present-day power structures.

Another key gap identified in the workshop was a poor understanding of the benefits of “noncompliance” with public regulations. Participants presented the anecdote of operators who receive fines even after paying large sums to comply with local regulations (by acquiring permits or upgrading vehicles to meet standards). The operators then make an economic decision to not comply, accepting fines as the least-expensive approach. Participants also discussed the related issue of police corruption, which was cited as contributing to noncompliance. Research into police corruption would benefit from examining police wages.

Issues around transparency and the lack of available information were mentioned by workshop

participants, with the example of Manila allocating 99 percent of its transportation budget to rail. Participants noted challenges related to the political economy and raised questions about how it operates. Research opportunities could include investigating the role of civic tools like participatory budgeting and planning as a means to combat the opaqueness of decision-making and differences in efficacy.

4.5. COVID-19

While there is very little existing research on paratransit and shared mobility services and the coronavirus, all of the interview and workshop discussions touched upon the pandemic's immediate effects on the urban transportation landscape. All of the interviewees, who represented nearly every global region, described the crippling effects of the pandemic on shared mobility services and paratransit operations, but the effects were different in different contexts. Some interview subjects described how national or regional governments are recognizing the need to fund transportation services (specifically informal transport), as paratransit operators became the sole means of transport for essential workers when formal services were shut down.

Additionally, the COVID-19 pandemic has highlighted and spurred increased interest in the movement of goods during crises and how disruptions to goods movements impact cities. The ITDP research team heard consultants' anecdotes regarding the urban freight sector being a critical element in providing essential food, medicine, and materials during the pandemic. This was primarily tied to the shared mobility services sector (mainly ride-hailing), but included non-motorized transport, such as bike-share. Furthermore, the conversations highlighted the need for additional research on drivers and operators of urban freight and how COVID has affected the sector.

4.6. Consultations & Feedback

The ITDP research team developed additional findings based on the workshop and interviews with the experts and researchers. First, interview subjects and workshop participants identified the following research gaps and issues:

- The lack of literature on engagement strategies with operators, drivers, associations, and unions is a key research gap that was highlighted on numerous occasions in our consultations. More knowledge of different communication approaches and capacity-building exercises will help drive the adoption of varying professionalization methods and/or technologies to enhance services.
- There is a need for research to improve understanding of the business priorities and operational strategies of actors in the private sector. More information on business propositions and industry practices (qualitatively and quantitatively) is strongly needed as

well. Further, many participants mentioned the need for increased knowledge about additional examples of paratransit integration approaches taken by governments.

- Due to issues of power, the paratransit industry may be sensitive to examinations of how it functions. Any close examination of the industry will require a long-term commitment and sustained funding to enable researchers to establish trust with research subjects. Only then can they fully understand the nuances and intricacies involved.
- There is also a lack of sufficient researcher capacity on paratransit. Paratransit studies is not taught in many universities, leading to a lack of interested researchers. Issues of security may also dissuade researchers from engaging in the subject.

The workshop provided additional insights on research themes that should be considered when engaging in future studies. These themes include:

- Gender Inequity and Inequality
- Explosion and Life Cycles of Digital Platforms
- Paratransit and the Informal Economy
- Relationships Between Urban Freight and Passenger Services
- Supply Chains and Physical Access to Vehicles
- Tech Adoption (by modes, associations, operators)
- Passenger Preference and Participatory Budgeting

Workshop attendees also participated in a poll in which they prioritized research topics. They were asked the following question (results below):

Which research area would you like to see more resources dedicated towards? (Choose only one.)

| percentage of participants | Research Topics |
|----------------------------|---|
| 60 | Financing models/opportunities to subsidize the paratransit sector |
| 20 | Urban freight and impact on cities |
| 10 | Data management/sharing/integrity |
| 10 | COVID-19 and formal/informal transport recovery |
| 0 | Paratransit/shared mobility planning and operations |

5. Findings

There is a lack of research on the implications and impacts of policy actions addressing shared mobility and paratransit, especially from lower-income and middle-income countries. Research on government commitments and subsidies, specifically with respect to payment schemes for operators and how the government advances this agenda, is also scarce.

The workshop provided the ITDP research team with an opportunity to learn more about the research challenges that need to be considered in future studies on paratransit and shared mobility. The participants noted the following issues regarding planning future research endeavors on the subject:

- Issues of security
- Long-term research commitments
- Sustained funding
- Different research approaches (anthropological, interdisciplinary, action, etc.)
- Current incentives for academia
- Institutions/programs/actors engaged in the subject.

| Key Literature Gaps | | |
|---|--|---|
| Current Service Impacts | Transport Management | Paratransit Improvement |
| <ol style="list-style-type: none"> 1. Quantitative research 2. Shared mobility research outside North America that looks at services beyond ride-hailing 3. Environmental research that looks beyond carbon emissions 4. Additional research on employment and the economic impacts of paratransit and shared mobility services on workforce opportunities, wages, and driver quality of life | <ol style="list-style-type: none"> 1. Government capacity requirements for effective management of public transport systems 2. Allocation of financial risk between governments and operators 3. Role of governance in implementing smart-mobility solutions 4. Regulatory responses to shared mobility in the global South 5. Examples of successful data collection and management, specifically regarding service planning (paratransit), operator censuses to inform transformation processes (paratransit), and security and privacy (shared mobility) 6. Insights into business propositions and models used by operators 7. The relationship between paratransit and urban freight | <ol style="list-style-type: none"> 1. Effective business models for paratransit service (e.g., net cost, gross cost, etc.) 2. Use of government subsidies to spur service improvements 3. Role of paratransit operators and drivers 4. Substantive examples of integration /consolidation of transport modes, including integrated fare structures and integrated payment media |

Paratransit and shared mobility services play important roles in a city’s transport network. In this paper, we developed a baseline of knowledge on their impacts, management practices, and policy actions to improve them. This state of knowledge can help decision makers shape a more effective transport system and help researchers fill in gaps in knowledge. While there is significant literature on these services broadly, there are under-studied areas in which additional examination is required to develop a more comprehensive research foundation. We found significant research gaps across geography and modes that should be prioritized in future research. Addressing issues like data and privacy for shared mobility and developing different research approaches and timelines for paratransit operations research will require more time and resources. Ultimately, the more research that can address these gaps, the better strategies and policy actions can be used to integrate and improve service for all users.

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Appendix A: Nicknames of mode types

| Nickname | Mode Type | Country |
|-----------------------|-----------------|---------------|
| <i>Jeepney</i> | Minibus taxi | Philippines |
| <i>Habal-Habal</i> | Motorcycle taxi | Philippines |
| <i>Danfo</i> | Minibus taxi | Nigeria |
| <i>Rickshaw</i> | Pedicab | Philippines |
| <i>Dala dalas</i> | Minibus taxi | Tanzania |
| <i>Tro-tro</i> | Minibus taxi | Ghana |
| <i>Matatu</i> | Minibus taxi | Kenya |
| <i>Car Rapidas</i> | Minibus taxi | Senegal |
| <i>Kamung</i> | Minibus taxi | Uganda |
| <i>Gbaka</i> | Minibus taxi | Côte d'Ivoire |
| <i>Esprit de Mort</i> | Minibus taxi | DRC |
| <i>Candonqueiros</i> | Minibus taxi | Angola |
| <i>Poda-Poda</i> | Minibus taxi | Sierra Leone |
| <i>Sotrama</i> | Minibus taxi | Mali |

| | | |
|-------------------------------|-----------------------------|-------------------------------|
| <i>Kombi</i> | Minibus taxi | South Africa |
| <i>Songa Kidogo</i> | Minibus taxi | Rwanda |
| <i>Okados</i> | Motorcycle taxi | Nigeria |
| <i>Camionetas</i> | Minibus/minivan taxi | Mexico/Central America |
| <i>Tuk-Tuk</i> | Autorickshaw | Multiple Countries |
| <i>Tempos</i> | Minibus | India |
| <i>Ojek</i> | Motorcycle taxi | Indonesia |
| <i>Xe om</i> | Motorcycle taxi | Vietnam |
| <i>Angkutan Kota (Angkot)</i> | Minibus taxi | Indonesia |
| <i>Pete-pete</i> | Minibus taxi | Indonesia |
| <i>Bemo</i> | Minibus taxi | Indonesia |
| <i>Vikrams</i> | Autorickshaw | India |
| <i>Tata Magic</i> | Microvan | India |
| <i>Mikrolet</i> | Minibus taxi | Indonesia |

Appendix B: Breakdown of reviewed documents by theme

| | | North America & Latin America | Europe | Asia & the Pacific | Africa & the Middle East | Global | Total |
|--------------------------------|-----------------|-------------------------------|--------|--------------------|--------------------------|--------|-----------|
| Current Service Impacts | | | | | | | 82 |
| Access | Paratransit | 1 | | 3 | 1 | | 5 |
| | Shared Mobility | 6 | 1 | 2 | 2 | | 11 |
| Equity | Paratransit | 1 | | 2 | 3 | 6 | 12 |
| | Shared Mobility | 8 | 1 | | | | 9 |
| Employment | Paratransit | | | 1 | 5 | 3 | 9 |
| | Shared Mobility | 5 | | | | 1 | 6 |
| Safety | Paratransit | 1 | | 4 | 1 | | 6 |
| | Shared Mobility | 3 | | 1 | | 1 | 5 |
| Environment | Paratransit | | | 3 | 1 | | 4 |
| | Shared Mobility | 5 | 1 | 4 | | 5 | 15 |
| | | | | | | | |

| | | | | | | | |
|-------------------------------------|-----------------|----|---|----|----|---|------------|
| Transportation Management | | | | | | | 71 |
| Governance | Paratransit | 2 | | 19 | 3 | 1 | 25 |
| | Shared Mobility | 14 | 4 | 3 | | | 21 |
| Business Models | | 3 | | 1 | 1 | 4 | 9 |
| Mobility Relationships & Management | | | | 1 | 1 | 1 | 3 |
| Data Management | | 2 | 1 | 2 | 3 | 5 | 13 |
| | | | | | | | |
| Paratransit Improvement | | | | | | | 24 |
| Paratransit Integration | | 1 | 1 | 1 | 2 | 3 | 8 |
| Subsidies & Payments | | 1 | 1 | 2 | 10 | 2 | 16 |
| | | | | | | | |
| Total | | | | | | | 177 |

Geographical Focus of Literature Reviewed



Appendix C: Workshop Participants and Agenda

Workshop Participants:

- Roger Behrens (Centre for Transport Studies, University of Cape Town)
- Gina Porter (Durham University)
- Jeff Turner (Institute for Transport Studies, University of Leeds)
- Benjie de la Pena (Makeshift Mobility)
- Ben Welle (World Resource Institute)
- Julia Nebrija (Agile City Partners)
- Thet Hein Tun (World Resource Institute)
- Christopher Kost (ITDP)
- Jacob Mason (ITDP)
- Stanford Turner (ITDP)
- Nour El Deeb (ITDP)
- Mariam Sorour (ITDP)
- Sarah Cassius (ITDP)

Workshop Agenda:

- Introductions
- Research Background & Scope
- Presentation of Preliminary Results
- Discussion #1: Power, Politics, & Corruption
- Break & Poll Question
- Discussion # 2: Initial Feedback and Research Gaps and Priorities
- Closing remarks