App-Based Shared Mobility: An Exploratory Study

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App-Based Shared Mobility: An Exploratory Study

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Disclaimer

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Abbreviations and Acronyms

Abbreviations	Expansion
ASM	app-based shared mobility
CA	cab aggregators
CSTEP	Center for Study of Science, Technology and Policy
CV	coefficient of variance
CVTs	clean vehicle technologies
EV	electric vehicle
GPS	Global Positioning System
GPRS	General Packet Radio Service
Gt	gigaton
IQR	interquartile range
IT	information technology
km	kilometre
KYC	Know Your Customer
LCA	life cycle assessment
MoRTH	Ministry of Road Transport and Highways
MV Act	Motor Vehicle Act
PUC	pollution under control
SD	standard deviation
VKT	vehicle kilometres travelled

Executive Summary

The new urban mobility services are expected to reduce the global carbon dioxide (CO_2) emissions from urban passenger transport modes. Of the new mobility services, shared mobility will have a larger contribution in reducing CO_2 emissions. App-based shared mobility (ASM) is a form of on-demand service that promotes shared rides/vehicles through various transport modes (two-, three-, or four-wheelers, or mass transit modes—vans and buses).

With the expected growth of shared mobility, it is important to identify challenges along with policy recommendations. As ASM has evolved at a rapid pace, policy responses have not been able to capture crucial emerging concerns—such as wage protection for drivers, surge pricing, impact on public transport (PT), congestion, and private vehicle ownership. Thus, it is important to understand the policy landscape and prepare a roadmap to improve the services. Most Indian states currently depend on the Central Motor Vehicle (MV) Act (1988) and MV Amendment (2019) for taxi regulations, while a few have drafted/issued cab/bike/bus policies/notifications in addition to the existing MV Act.

In an effort to understand the key policy imperatives in the ASM ecosystem, the Center for Study of Science, Technology and Policy (CSTEP) has undertaken this exploratory study. The study considered the sustainable-mobility theme with the following aspects:

- **Environmental sustainability:** Focus on lowering carbon footprint and air pollution
- **Economic sustainability:** Discussion on business models and financial viability
- **Social sustainability:** Focus on driver and commuter safety and security
- **Institutional sustainability:** Focus on ASM institutional integration and government–aggregator data sharing

This study involved engaging with relevant stakeholders—aggregators, government officials, and civil society organisations (CSOs)/academia—through extensive interviews to understand current ASM policies and challenges. The study offers valuable insights on the key policy questions and constraints in the ASM ecosystem. In addition, the study highlights the ASM aggregators' requirements regarding preferential paid parking, market-driven pricing, pan-India common permit, etc., for ease of operations.

The study recommends incentives for clean vehicle technologies (CVTs), promoting high occupancy, peer-to-peer car-pooling, passenger safety, data sharing, and institutional capacity building in policy formulation. The states need to proactively develop new mobility policies in line with technological innovations in urban mobility. These policies should focus on contributing to sustainable urban mobility. A nodal agency needs to be set up under the Unified Metropolitan Transport Authority (UMTA) to regulate and oversee the operations of new mobility services.

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1. Introduction

New mobility services emerging in urban transport are an integration of various modes of transport via smart infrastructure, accommodating autonomous vehicles, integrated electric vehicles and shared mobility. Globally, new mobility services are predicted to reduce 80% of CO_2 emissions from urban passenger transport modes by 2050, and shared mobility will have a larger contribution (Fulton, Mason, & Meroux, 2017). Shared mobility is predicted to grow rapidly (Shaheen, 2016), and India is expected to be the shared mobility leader by 2030, contributing 35% of the miles travelled worldwide, which will increase to 50% by 2040 (Morgan Stanley, 2018). Further, in India, shared mobility along with an electrification strategy will reduce 1.5 Gt of CO_2 emissions by 2035 (NITI Aayog, RMI, and ORF 2018). The issue of urban air quality has gained significant importance in many Indian cities; therefore, with the projected growth of shared mobility, it is important to explore existing challenges along with policy recommendations.

The shared mobility services include car sharing[1], carpooling[2], e-hailing[3] (ridesharing and ride sourcing) and demand-responsive transport[4] (Finger & Audoin, 2019). App-based shared mobility (ASM) is a form of on-demand services and promotes shared rides/vehicles through various business models and transport modes (two-, three-, or four-wheelers, or mass transit modes—vans and buses).

ASM services are rapidly increasing as they offer mobility choices, ensure seamless travel, reduce private vehicle ownership and complement public transport (PT). Though their impact on urban cities is still debated, when appropriately regulated and incentivised, ASM services have the potential to reduce private vehicle use, address traffic congestion, reduce air pollution and optimise infrastructure use. Thus, ASM services can be part of the low-carbon mobility strategies and reduce CO_2 emissions from urban transport.

Enabling a policy and regulatory framework considering the technological innovations and business models is needed to harness the benefits of ASM services. However, the current ASM policies focus mainly on entry regulations and do not focus on emerging issues such as environmental impact, PT, traffic congestion, drivers' wage protection and surge pricing[5]. To

[1] Car sharing: Sharing of vehicle between individuals
[2] Carpooling: Sharing of vehicle journey by vehicle driver with other people
[3] E-hailing: Ridesharing and ride sourcing (driver provides ride based on passenger's needs and booking via a dedicated platform)
[4] Demand-responsive transport: Service operates when and where users demand
[5] Surge pricing –Dynamic pricing or surge pricing refers to the increase in price due to increase in demand for rides especially during peak hours

address these issues, it is essential to understand the interests of the stakeholders involved, identify their concerns and translate them into actionable policy recommendations. The aim of the study, hence, is to articulate key policy questions relating to ASM through stakeholder engagement.

India's first attempt at regularising ASM services came in the form of taxi guidelines from the Ministry of Road Transport and Highways (MoRTH) (MoRTH 2016b) to promote urban mobility and regulate operations. Prior to this, the states depended on the MV Act (*The Motor Vehicles Act* 1988) to regulate the operations of cab aggregators[6]. Soon, states like Karnataka, Maharashtra, West Bengal, Rajasthan, Delhi and Uttar Pradesh formulated rules based on the taxi guidelines. These state notifications largely focus on licence requirements, vehicle profile, driver qualification, operations, fare regulation, and data storing and sharing. By neglecting issues like environmental impact, PT, traffic congestion, accessibility for different communities, wage protection for drivers and surge pricing, they reflect a limited understanding of the ASM ecosystem. Thus, identifying the key policy aspects to suit the changing ASM ecosystem is a priority for urban policymakers to ensure they contribute to sustainable urban mobility.

1.1. Need for the Study

The current policy responses with the gaps, concerns and poor acceptance by the stakeholders are a constraint in maximising the benefits of the ASM ecosystem. To address these, it is essential to understand the interests of the involved stakeholders, identify their concerns, and translate them into actionable policy points. For a larger picture, it's essential to distinguish and understand each stakeholder's (aggregators, drivers, commuters, government officials, CSOs etc.) role and contribution to sustainable urban mobility.

1.2. Aim and Objectives

Aim:

- To articulate key policy questions relating to app-based shared mobility (ASM) through stakeholder engagement

Objectives:

- To understand the policy issues in the ASM ecosystem
- To engage with stakeholders (operators/entrepreneurs, government officials) to identify policy imperatives

[6] The terms "aggregators" and "operators" are used interchangeably.

1.3. Scope and Limitations

Scope:

- The scope of the study extends to engaging with ASM stakeholders, including government officials, aggregators/operators and academic experts.
- The geographical scope of the study extends to states across India.

Limitations:

- The study is limited to passenger ASM.

2. Analytical Framework

The framework of this study consists of three interdependent components: new mobility options, stakeholders and the existing policy framework (Figure 1). Of the new mobility options, the study focuses on ASM, as it has been influencing the Indian urban transport landscape at a rapid pace, with very few studies to understand the impact as well as the perspectives of the players involved.

New mobility options influence the behaviour of the stakeholders. While these options provide better mobility solutions to commuters and employment opportunities to drivers, they also necessitate revision of the existing governing structure and introduction of new policies. Various global and national approaches to ASM services form a knowledge database that cities often learn from and adopt contextually.

The three components help in understanding the policy gaps in achieving sustainability from environment, economic, social and institutional perspectives. In a multiplayer ecosystem such as this, it is imperative that any action planned is in the best interest and is consensual to all the players involved. In this regard, stakeholder consultations form the crux in forming policy recommendations and identifying the potential scope for further studies.

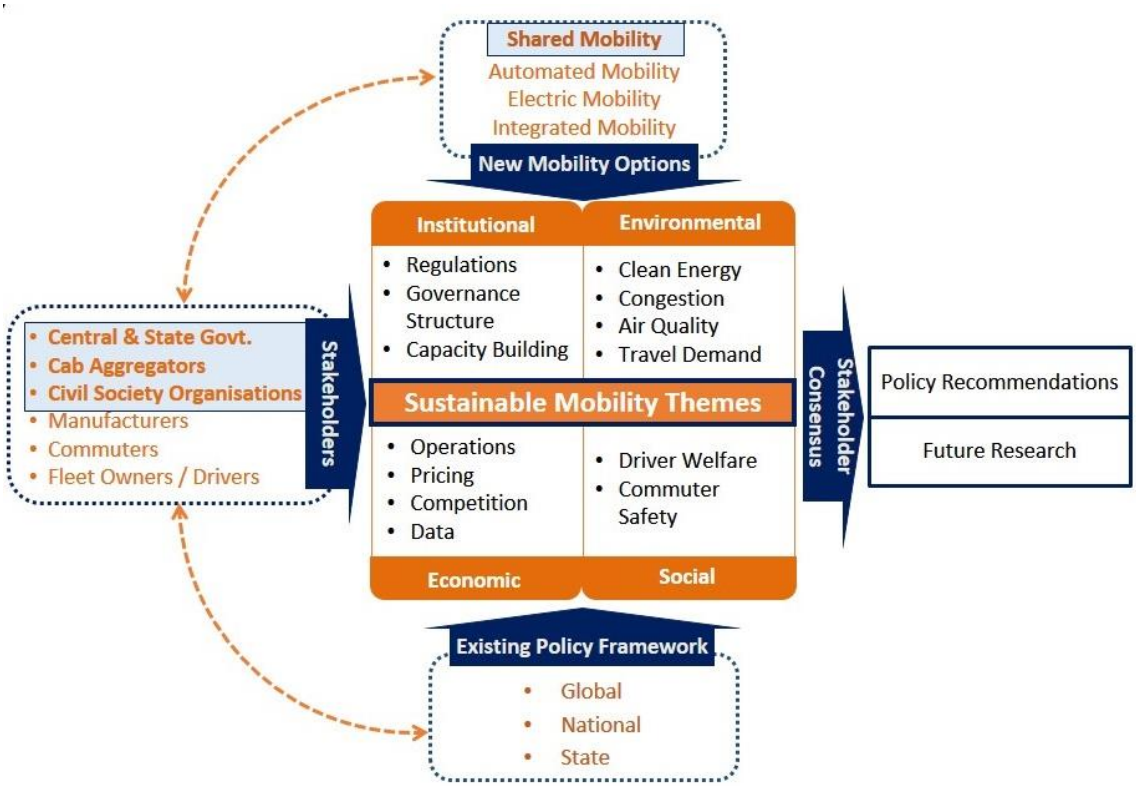

Figure 1: Analytical framework for ASM exploratory study

3. ASM Ecosystem

3.1. Business Models in ASM

Shared economy is a term for the new-era asset sharing transactions where people coordinate the distribution and utilisation of assets for a fee or other compensation. The platforms enabling shared economy are multisided markets where two or more user groups perform transactions and all benefit directly or indirectly from the transaction (Codagnone and Martens 2016). Shared mobility, a branch of the new-era shared economy, facilitates the distribution and efficient use of vehicles.

Shared mobility was a part of urban transport even before smartphones and mobile applications were developed. The aggregator model, then, had three players—commuters, vehicle owners and booking providers. The commuters availed the taxi services from the vehicle owners through the booking providers, usually via a telephone (Darbéra 2017). Later, an ownership model was developed, wherein large fleet owners directly provided taxi services accessible through mobile applications. In India, Meru was a pioneer in providing these services since 2007. It then adopted the hybrid operation model, introduced by Ola in 2010, which focused on revenue generation along with service provision. The model is driven primarily by providing premium car services, surge pricing in peak hours and underserved areas, charging for delays, different price ranges for different car models, etc. This model consists of service providers or aggregators, the drivers associated with the aggregators who either lease or own the cabs, and the commuters. When the aggregator gets a request for a trip by a commuter, all drivers in the proximity are alerted for the request. The driver accepting the request is connected with the commuter, with the trip beginning once the commuter boards the cab.

Backed by venture capital, the aggregators focus on attracting drivers, acquiring customers and aiming for ambitious geographical expansion. Most aggregators adopt the demand-driven-supply model with surged fares during high demand hours, night hours, and in underserved areas. This is a dynamic pricing mechanism that ensures the drivers are available at all times, in all areas. The drivers are enticed with incentives for enrolling and reference, along with 80–85% of the passenger fare (Karthick S & Ramakrishnan, 2017). Moreover, they have flexible working hours; they are independent contractors or driver-partners rather than employees. Though it encourages micro-entrepreneurship and improves the driver's livelihood and social status, they are not eligible for employee benefits like regularised working hours, insurance, holidays, etc. (Karthick S & Ramakrishnan, 2017).

The aggregators are also venturing into diverse business models to include food/goods delivery to make their operations more economically sustainable. With the operations evolving rapidly to

cope with changing commuter behaviours and expectations, it would be essential to understand how these are treated in various contexts across the globe.

3.2. Impact of Shared Mobility

Prior to policymaking, it is necessary to understand how supportive (or obstructive) the new technological services are to the mobility, environmental, economic and social goals of a city. The lack of data has restrained this understanding. Nevertheless, several attempts have been made globally to study how these services are impacting traffic congestion, emissions, PT, and taxi services.

Impact of Ride-Hailing Services on PT

Studies across US cities showed that with the evolution of ride-hailing services, people use more of PT (Murphy 2016; Hall, Palsson, and Price 2018). It was also found that these services complement PT and enhance mobility by serving underserved areas and providing a commuting option during off-peak hours and night-time.

In contradiction to this, another study in major US cities (Boston, Chicago, Los Angeles, New York, Seattle, New York, San Francisco, Seattle and Washington, DC) found that ride-hailing services could either complement or substitute the PT systems, depending on the mode of transit (Clewlow and Mishra 2017). According to the results of a web-based survey, while ride-hailing substitutes for 6% and 3% of bus and light rail trips, respectively, they complement 3% of commuter rail trips.

Impact of Ride-Hailing Services on Congestion/Traffic Pattern

A study in major US metropolitan areas where difference in difference analysis[7] was performed to understand the impact of ride-hailing services on congestion showed that they reduced traffic congestion. Another study in major US cities (Austin, Boston, Chicago, Los Angeles, San Francisco, Seattle and Washington, DC) highlighted that people would spend lesser on commute, and private vehicle ownership may see reduction in number(Murphy 2016). An analysis of trip data from Lyft and published surveys from select US cities (Boston, Chicago, Los Angeles, Miami, New York, Philadelphia, San Francisco, Seattle and Washington, DC) showed that ASM services added 5.7 billion trips annually to the city traffic (Schaller 2018). Another study inferred that for the people not using PT, vehicle ownership is independent of availability of ride-hailing services and that these services would increase the vehicle kilometres travelled (VKT) in the cities (Clewlow and Mishra 2017). Moreover, the study highlighted that 49–61% of the ride-hailing trips are either induced or a substitution to walking, biking and transit, bringing more vehicles on to the roads.

[7] Difference in difference (DID) is an approach to compare the outcomes before and after an intervention on groups that are exposed to the intervention and those that are not (Dimick and Ryan 2014).

Identical attempts were made in India too, to understand how these services alter urban mobility. A study was carried out in Bangalore, Delhi, Kolkata and Mumbai to assess the impact of ridesharing on traffic congestion(Chin et al. 2018). From the study, it was found that ridesharing accounts for almost two times higher people kilometres per vehicle per year as compared to private vehicles, indicating a higher rate of utilization for vehicles. In the survey, 80% of the commuters stated that provided the desired level of service from ASM options, they would avoid owning a vehicle. The study highlighted that these services had the potential to reduce private vehicle usage by 33–68% and congestion by 17–31%, and this reduction could be translated to saving around 760–22,000 acres of land of parking space in each city.

Socio-Economic Impact of Ride-Hailing Services

A study carried out in Bengaluru, Delhi, Hyderabad, Kolkata and Mumbai aimed at understanding the socio-economic impact of cab aggregators showed that 79% of the driver-partners have better earnings, while 54% of the traditional cab drivers' and 52% of the auto rickshaw drivers' earnings were negatively impacted by the entry of the aggregators (Jaiswal, Gupta, Aeron, & Gupta, n.d.). Owing to the increase in incomes of the driver-partners, 46% of the respondents claimed that their housing facilities have improved. From the study, it was evident that 92% of the driver-partners drive 100–300 km daily to maintain their incomes, and consequently, 46% of the driver-partners observed a negative impact on their health due to overworking. The drivers associated with the aggregators stated that about half of their earnings came from incentives from the companies. This could be perceived as a socially unsustainable observation that may require attention. This observation is supported by the analysis that noticed a significant drop in driver incentives from the second quarter of 2016, owing to the aggregators' cost-cutting measures. Consequently, the drivers' supply steeply fell and the ride fares swelled (RedSeer Consulting 2017).

From different studies, it is evident that ride-hailing services can impact PT, congestion and socio-economic status of the drivers. These findings are often varied and subject to the nature and scope of the research conducted.

3.3. Global Concerns and Policy Approaches

Globally, the advent of ASM services has received mixed responses from commuters, drivers and policymakers. While commuters are enjoying seamless connectivity, they have also raised concerns on safety and exorbitantly increasing ride fares. The drivers, who initially enjoyed the flexibility and lucrativeness of the business model, have lately begun complaining of decreasing incentives in several cities like New York and Chicago. The policymakers also have been wary of the impact of these services on urban mobility and are looking for means to provide a fair

environment for all the players. The governments of some regions like British Columbia, Bulgaria, Denmark, Hungary, Jordan, Oman and Turkey (Daus 2018) have banned these services on account of data breach, opposition from traditional taxi drivers, licensing issues or passenger safety. Some of the most discussed policy approaches to ensure driver welfare, fair pricing, levying of tax for infrastructure development, efficient operations, traffic control and data sharing are reviewed here.

Operations and Traffic Control

To minimise the total vehicle kilometres travelled (VKT) by the aggregated vehicles, Sao Paulo mandates the companies to buy mileage credits based on the bimonthly kilometres driven. This VKT includes deadheaded miles as well. Companies exceeding the credits bought are penalised with a surcharge. This measure forces them to optimise their routing and operations, consequently reducing road congestion (Yanocha and Mason 2019). In a step to control congestion and mutual competition among drivers, New York sought to freeze the 'for-hire vehicle' registrations, including those registered on various platforms, for one year and is likely to extend the freeze depending on the consequences observed (Marshall 2019).

Service Tax for Infrastructure Development

With the motives to charge for the road space utilised and improve the existing transportation system, several cities have sought to tax rides hailed on platforms by various means. Cities levy, based on per ride or per mile driven, flat taxes or flexible taxes that vary temporally and geographically, and are usually spent on funding urban mobility development projects.

Mexico City charges a 1.5% tax on all rides, and this tax is spent on funding taxis and improving transport infrastructure (Welle et al., 2018). Sao Paulo collects a $0.04 tax per mile travelled, which is directed towards achieving its mobility goals. However, the city provides discounts for rides made with higher occupancy, electric vehicles, accessible vehicles, women drivers or in-transit deserts[8]. Fortaleza levies a 1–2% tax on the fare, and it is invested in reducing road usage. Washington, DC charges tax equal to 6% of the fare, of which 17% is allocated to the Department of For-Hire Vehicles and the remaining to the Washington Metropolitan Area Transit Authority. Through this tax, the city aims to raise $178.5 million to fund the Metro (Siddiqui 2018). New York collects tax equal to 8.875% of the fare, and it is shared by the state and the city's general fund. In addition, a surcharge of $2.75 per ride or $0.75 per pooled ride is collected in lower midtown Manhattan. This surcharge, which could amount to $1 million a day (Hu 2019), is used by the Metropolitan Transport Authority to improve the subway operations. Chicago collects $0.69 per ride, and it is mostly used to incentivise on-demand transport for commuters with

[8] Area with limited transportation supply

disabilities. Rio de Janeiro imposes tax equal to 1% of the ride fare, and it is used to upgrade the existing transportation infrastructure, provide road safety awareness and fund the government-run ride-sourcing app Taxi.Rio (Yanocha and Mason 2019). Australian cities levy between $1 and $2 per ride to provide compensation for the taxi industry impacted by the ride-hailing services (Thompson 2017).

Fare Regulations

The governments of certain countries like Malaysia have capped the surge at a maximum of two times the ride fare, to ensure a fair market and commuter affordability (Izahar 2018). Similarly, UAE mandates that the companies match their fares with those of the traditional taxis (Daus 2018). While such fare-control measures are aimed at ensuring commuter affordability and fair competition with traditional taxi services, they could also disturb the demand-driven model adopted by the aggregators. The absence of a lucrative dynamic pricing model defies the basic idea of operating the on-demand services.

Data Sharing

The city authorities can use the data collected by the aggregator companies to evaluate their impact on urban mobility, frame policies, and also plan and manage urban mobility systems. The regulations in Sao Paulo and Fortaleza mandate the companies to share data regarding trip origin, destination, length, duration, cost and route along with the driver ID number. Chicago seeks trip origin and destination, vehicle details, driver details and details of crashes involving vehicles on the platform. On a similar line, London plans to collect trip data to understand the reasons for reducing PT ridership and commuter choice patterns (Yanocha and Mason 2019). However, the companies have been hesitant to share their data due to fear of exposure to competitors, concerns over user privacy protection and lack of laws governing data sharing.

Managing Mobility Data is a guideline and a part of the National Association of City Transport Officials (NACTO) Policy 2019, formulated by 81 North American cities and transit agencies. Addressing the need for a framework that guides sharing, managing and protecting mobility data in a secure manner, the guideline defines principles for managing mobility data, explains the challenges in maintaining privacy and shares the best practices (NATCO and IMLA 2019).

In an attempt to address these concerns, cities like Seattle have housed third-party operators to handle and protect data. The Transportation Data Collaborative at the University of Washington ensures data is protected from disclosure and also facilitates data analysis by third parties in case the authorities lack the expertise to do so (TDC, n.d.).

Driver Welfare

Employee Categorisation

App-based transport companies across the globe claim that the drivers on the platform are given the freedom to choose a driving assignment and their working hours, subject to a certain minimum, and hence are considered 'driver-partners' or individual contractors rather than employees. This claim, if accepted, exempts these 'partners' from the purview of the labour laws and employee benefits. Many drivers worldwide have expressed distress over inconsistent incomes, long working hours, and growing competition.

In their latest verdict, the US National Labor Relations Board and the Department of Labor upheld that the drivers are not employees of Uber, citing that the level of freedom given is in conflict with the traditional definition of employees (Scheiber 2019). This claim is being contested globally by governments and drivers on account of the unilaterally fixed fares and the companies' control on the drivers' conduct (Kumar 2017). The UK Employment Tribunal in 2017 held that as long as the driver has switched the app on and is within the operational territory, he is a 'worker' for Uber (UK Employment Tribunal 2016). Similarly, California's Assembly Bill 5(Gonzalez 2019) identifies gig workers as employees. This would make the on-demand drivers, couriers and other independent contractors eligible for minimum wages and vacations similar to employees. Brazil (Haynes 2017) and New York (Griswold 2016) also have contested the claims of the companies. Such ambiguous clauses in the contract leave the drivers with neither the flexibility of independent freelancers nor the financial and legal security of employees. However, while their categorisation as employees would give them more financial stability and support, it would swing the control more towards the aggregator companies. The companies, then, may control their working hours, area of operations and also the number of drivers logged on at any point of time to ensure the demand–supply-based model is still financially viable to them. This possibility has left the driver-partners divided in their opinion on the categorisation.

Driver Incomes

In Indonesia, the drivers are overworking to earn decent wages and demanded an increase in ride fares. As a response to this, the government plans to set fixed fares at $0.43 per km (Silviana and Potkin 2019) and $0.14 per km (Mariano 2019) for ride-hailing cars and motorcycle taxis, respectively. Similarly, in New York, as of 2018, the drivers made an annual income of $20,000 (after vehicle expenses) (Molla 2018), which is far below the $70,000–$90,000 Uber had claimed its associated drivers were earning (McFarland 2014) and also below the poverty guideline (Department of Health and Human Services 2019). In response, New York, in early 2019, endorsed a minimum wage pay for the drivers, aligning it to the city's employees' minimum wage

of $15 per hour(Holley 2018). This would translate to an average 22.5% increase in their net income (Griswold 2016).

Commission to Companies

Drivers globally have also been complaining about aggregator companies charging them a commission of around 25% of the ride fare (Ridester 2019), affecting their already decreasing incomes. The regulations in Malaysia restrict the maximum commission chargeable to 10–20% of the ride fare (Izahar 2018).

From the discussion above, it is clear that issues arising are largely dependent on travel behaviours, socio-economic conditions, interests of policymakers and the existing transportation infrastructure. It is necessary that the policy solutions not only respond to specific issues but focus on the ecosystem's potential to improve sustainable mobility, from a wider perspective. Capping the number of vehicles or the VKT to levying taxes on rides are attempts to ensure these services positively contribute to sustainable mobility. Monitoring competition and ensuring the drivers are paid adequately are also solutions to guarantee the drivers are not compelled to travel extra kilometres looking for rides and increasing traffic congestion.

3.4. National-Level Policy/Guidelines

The Motor Vehicle Act was passed in 1988 "to consolidate and amend the law relating to motor vehicles" in India. The act has undergone several amendments to accommodate the changes in the transport sector. However, the act, until the latest amendment in 2019, did not recognise cab aggregators as a separate entity, treating them as taxis/motor cabs. Successive governments have made attempts to bring the aggregators under the regulatory lens.

In one such attempt, the MoRTH introduced Taxi Policy Guidelines in 2016 (MoRTH 2016a). The aim was to provide a regulatory framework to promote shared mobility, liberalise existing taxi permits and encourage new urban mobility services as alternatives to car ownership and lower entry-level barriers for shared mobility aggregators.

The guidelines covered vehicles under City Taxi Permits, All India Permits for Tourist Transport Operators (AITP), Radio Taxi Permits and Rent a Cab (For Car Rentals). MoRTH also detailed the terms and conditions for on-demand IT-based transportation aggregators to operate within the jurisdiction of state transport departments (MoRTH 2016a). Table 1 lists some points mentioned in the guidelines.

Table 1: Policy guidelines by MoRTH

Title: *Licensing, Compliance and Liability of On-Demand Information Technology–based Transportation Aggregators* **Year**: 2016 **Type**: Detailed terms and conditions for on-demand IT-based transportation aggregators to State Transport Department	
Licence Requirement	• Aggregators should obtain licence under Section 93 of the MV Act • Must establish a driver-training program
Vehicle Profile	• Should meet emission standards prescribed and have a pollution under control (PUC) certificate • Should be equipped with a physical location tracking device and provision to print bills/receipts • Should hold commercial insurance policy • Should be equipped with an emergency safety button • Should be equipped with a first aid box
Driver's Qualification	• Should have a commercial driver licence of appropriate category • Should not have been convicted in the past seven years and should be verified by the police • Must hold a Reserve Bank of India KYC-compliant bank account
Operations	• Drivers are permitted to log on and off at their discretion • Drivers are permitted to operate on multiple platforms • Drivers must not solicit or accept street hails
Data Sharing	• Enable data transfer of the vehicle location, and vehicle and driver details to the data network of the Central or State Government whenever demanded
Fare Regulation	• State Governments or the authorities specified by them may notify the maximum fares to be charged
Safety	• Must facilitate the rider to submit their grievances or difficulties faced during travel • Must facilitate the rider to share the real-time location with minimum two people and contact the local police in case of emergency • Must display a clear picture of the driver and vehicle specifications for the passenger

With the amendment in 2019, the MV Act has recognised aggregators as "digital intermediaries or marketplaces which can be used by passengers to connect with a driver for transportation". This amendment gives the governments the power to regulate the services and control their operations. The following table discusses the major changes brought about by the amendment with regard to the aggregators.

Table 2: The Motor Vehicle (Amendment) Bill, 2019

Title: The Motor Vehicle (Amendment) Bill, 2019 **Year**: 2019 **Type**: Amendment	
Aggregators	• "Aggregator" means a digital intermediary or market place for a passenger to connect with a driver for the purpose of transportation • Aggregators to obtain licence from State Governments • Aggregator shall comply with the provisions of the Information Technology Act, 2000

3.5. State-Level Policy/Regulations

With most states depending on the Central Motor Vehicle Act (1988) Amendment (2019) for taxi regulations, few have taken a step forward by forming new taxi policies.

The policies adopted by different states for regulating ASM services are given in the tables below.

Table 3: State-level key regulations: Cab aggregators

State	Title of Act/Rule	Key Policy/Regulation[9]							
		Licence Requirements	**Permit**	**Driver Qualification**	**Driver's Working Hours**	**Data Sharing/Storing**	**Operations**	**Fare Regulations**	**Others**
Karnataka (Transport Department, Karnataka 2016)	The Karnataka On-Demand Transportation Technology Aggregators Rules, 2016	Minimum 100 taxis with permit holders	Covered with a contract carriage permit	Have a valid commercial driving licence to drive a taxi and have a valid PSV badge	As stipulated by Motor Transport Workers Act 1961	Maintain records of all the taxis regarding trips made, passengers travelled and fare collected	Permitted to operate on multiple platforms	Shall not be higher than the fare fixed by the Government	Maintain a call centre and a web portal with all details of ownership, services offered, fare structure, control room number, etc. GPS/GPRS-based tracking service be fitted in vehicles Annual structured training program
Maharashtra (Transport Department, Maharashtra 2017)	Maharashtra City Taxi Rules, 2017	Have registered office in the area of its operations	Shall be operated under "App-Based City Taxi Permit"			Copy of the bills should be maintained for three months	Shall not pick up passengers by street hailing	Fare cap applicable only for the vehicles with engine capacity less than 2000 cc	
West Bengal (Transport Department, West Bengal 2015)	Directives for On Demand Transportation Technologies Aggregators, 2015	Minimum 50 consent letters from permit holders of public service vehicles	A valid permit issued by the authority	Appropriately registered and licensed	Permitted to log on and off at their discretion	Data stored on the server have to be shared with the authority as and when required in public interest	Permitted to operate on multiple platforms		

[9] X: 1. Not mentioned in the policy
2. Depends on the MV Act or other policy for the said category

State	Title of Act/Rule	Key Policy/Regulation[9]							
		Licence Requirements	Permit	Driver Qualification	Driver's Working Hours	Data Sharing/Storing	Operations	Fare Regulations	Others
Bihar (Transport Department, Bihar 2019)	Bihar Taxi Aggregator Operational Directives, 2019	Minimum 50 taxis	X	Valid licence	X	Maintain records, in digital form, of all taxis	X	X	Adequate parking space for all taxis
NCT (Transport Department, Delhi 2016)	City Taxi Scheme, 2015	Minimum 200 taxis and maximum 2,500 with permit holders	Covered with a contract carriage permit under section 74 of MV Act	Have a valid commercial driving licence to drive a taxi and have a valid PSV badge	As stipulated by Motor Transport Workers Act 1961	X	Seek passengers through calls, mobile- or web-based applications or through street hailing.	Can charge for waiting time, flag down charges, night charges as per Transport Department	
NCR (Govt. of Haryana, 2016)	NCR Motor Cab (Taxi) Scheme, 2016	Minimum 5 taxis and maximum 250 with permit holders				X	X		
Assam (Transport Department, Assam 2019)	The Assam On-Demand Transportation Technology Aggregators Rules, 2018	X		Hold light motor vehicles licence		X	X	Shall not be higher than the fare fixed by Govt. No dead mileage charges	
Rajasthan (Transport Department, Rajasthan 2016)	Rajasthan On-Demand Information Technology–Based Transportation by Public Service	Minimum 50 taxis	Relevant permit to ply in the area and be validly registered	Driving licence of the appropriate category	Permitted to log on and off at their discretion	Data stored should be shared with the Central and State Govt. whenever demanded	Area of operation of vehicle as prescribed by the Rajasthan Motor	X	Maintain a call centre and a web portal with all details of ownership, services offered,

State	Title of Act/Rule	Key Policy/Regulation[9]							
		Licence Requirements	**Permit**	**Driver Qualification**	**Driver's Working Hours**	**Data Sharing/Storing**	**Operations**	**Fare Regulations**	**Others**
	Vehicles Rules, 2016						Vehicles Rules, 1990		fare structure, control room number, etc.
Madhya Pradesh (Govt. of Madhya Pradesh, 2017)	Madhya Pradesh Aggregator for the Hire of Motor Cab, Auto Rickshaw and Motor Cycle Rules, 2017	• Minimum 25 vehicles • Security deposit 10 lakh for cabs; 2 lakh for auto rickshaw	Relevant permit to ply in the area and be validly registered	Valid driving licence and PSV badge	X	X	Vehicle can operate in the authorised area	Fare charge fixed by Government	GPS/GPRS-based tracking service be fitted in vehicles
Gujarat (Transport Department, Gujarat 2018)	Gujarat State On Demand Transportation Aggregator Rules, 2018	Minimum 50 taxis and maximum 20,000 with permit holders	Be covered with a contract carriage permit	• Driving licence and the badge to drive motor cabs • Minimum driving experience of 2 years	X	Maintain record of all trip details and be open for inspection	Shall provide 24 × 7 services	Taxi fare shall not exceed four times the basic fare	Maintain a call centre and a web portal with all details of ownership, services offered, fare structure, control room number, etc.

Table 4: State-level key regulations: Bike taxis

States	Title of Act/Rule	Key Policy/Regulation						
		Licence Requirements	**Permit**	**Driver Qualification**	**Driver's Working Hours**	**Display**	**Safety**	**Others**
Haryana (Transport Department, Haryana 2015)	Contract Carriage Permit to Passenger Carriage, 2015	Licence is not transferable	Contract carriage permit to passenger carriage	The conduct of the driver and details should be know	X	"Contract Carriage" should be written on the vehicle	First-aid box should be available	• Meet emission standards • Owner should have enough parking space
Punjab (Transport Department, Punjab 2017)	Contract Carriage Permit to Motor Cycle Taxis as Passenger Carriages	X		Police verification of driver for the last six months at the place of residence	X		The vehicle should have first-aid box	Owner should have enough parking space
West Bengal (Transport Department, West Bengal 2016)	Bike Taxi Notification, 2017	Minimum 15 motorcycles should be owned by the service provider		Should have driving licence	Service period between 08:00 am to 08:00 pm	"Bike Taxi" should be written on the vehicle	GPS tracking of the vehicle/driver	
Uttar Pradesh (Govt. of Uttar Pradesh, 2016)	Conditions for Permit for Rented Commercial Motorcycles, 2016	X	X	X	X		First-aid box should be available	Tariffs are fixed
Rajasthan (Govt. of Rajasthan, 2017)	Rajasthan Bike Taxi Policy 2017	Licence validity-1 year Security deposit-INR 5,000	Contract carriage permit	• Should have driving licence • The conduct of the driver and details should be known	X			• Meet emission standards • Maximum fare should be fixed by Government

Most of the state notifications emphasise on the minimum fleet size with aggregators required to operate, but there is also a need to cap the fleet size (or their VKT) and ensure they do not contribute to congestion. Very few states have insisted on a contract carriage permit for the vehicles to associate with the ASM. The lack of this mention in most other states gives way to ambiguity on operations of different modes of transport. This has led to services like ridesharing, carpooling and bus sharing being encouraged in some states and banned in several other. While a few states mandate the storage of trip data and sharing with authorities as required, there has been no focus on how and what grounds this sharing shall happen. This gap and its interpretation has hindered the collection of data by the authorities. Regulations on bike taxis are in a nascent stage and need updating and uniform adoption across states. The following table summarises the existing policies in the ASM policy landscape in Indian states.

Table 5: Summary of existing policy components

Regulations	**States**												
	Karnataka	Maharashtra	West Bengal	Bihar	NCT	NCR	Assam	Rajasthan	Madhya Pradesh	Gujrat	Haryana	Punjab	Uttar Pradesh
Fleet Size	✦		✦	✦	✦	✦		✦	✦	✦			
Contract Carriage/Taxi Permit	✦	✦			✦	✦				✦	✦	✦	
Engine Profile		✦			✦	✦							
Drivers' Conduct	✦	✦	✦		✦		✦	✦		✦	✦	✦	
Drivers' Working Hours	✦	✦	✦		✦	✦	✦	✦					
Passenger Safety	✦	✦	✦	✦	✦	✦	✦	✦	✦	✦			
Data Sharing on Demand	✦		✦	✦				✦		✦			
Fare Regulations	✦	✦		✦	✦	✦	✦		✦	✦			✦
Bike Taxi Regulations			✦					✦			✦	✦	✦

✦ Indicates a mention of the component in the policy document

4. Measuring Stakeholder Consensus

As this study is based on stakeholder engagement and consultation, different sets of information from various stakeholders have been collected. The stakeholders here represent the group of experts in the ASM ecosystem with different backgrounds, aims and roles to play.

To understand the opinion of this group of experts on the policy imperatives in the ASM ecosystem, a consensus-measure exercise needs to be carried out. There are different approaches for consensus measurement such as face-to-face interactions, focus group discussions, workshops, etc. However, these practices require enough time and effort, which may not be feasible in the study timeline. Hence, this study adopted a systematic iterative method, the Delphi technique (Dalkey and Helmer 1962), to aggregate the responses from experts (Gracht, 2012)).

Delphi techniques have many practical advantages compared to other traditional methods. This technique replaces direct confrontation and provides anonymity of opinion and of arguments by collecting experts' opinion to a problem, usually through questionnaires (Brown 1968). Moreover, it is an economical, time-efficient methodology to reach an agreement between experts on policy issues that require informed decisions and judgements (Kalaian and Kasim 2012).

The aim of the Delphi technique is to collect views from a given panel of experts to help understand the future divergent views and orientations in the said ecosystem (Julsrud and Uteng 2015). A questionnaire needs to be sent to the group of selected experts through emails. As mentioned earlier, this method ensures anonymity of participants, thus allowing them to provide an unbiased and frank opinion. This leads to a higher response rate over other methods. A Delphi survey also has some disadvantages like late response, low response rate for Round 2, skipping of questions by the respondents, etc. (Kalaian and Kasim 2012).

4.1. Consensus Measure

Consensus measure plays an important role in the Delphi technique as it is based on the assumption that group judgements are more reliable than an individual's opinion (Giannarou and Zervas 2014). Consensus, either in agreement or disagreement with a statement, is defined as "a percentage higher than the average percentage of majority opinion"(Gracht 2012). To understand the degree of consensus level, decisions can be expressed on a Likert scale. The Likert scale provides a unidimensional scaling option to facilitate comparison. The choice to be made while using a Likert scale needs to be constant across participants for the direct comparison of responses (Tastle and Wierman 2017).

The literature review revealed that many studies have used descriptive statistics to measure the group consensus (Gracht 2012). Different methods such as mean, standard deviation, median

score, mode, interquartile range and coefficient of variance are used to arrive at a consensus value (Perveen et al., 2017; Jittrapirom et al., n.d.; (Trevelyan and Robinson 2015). Table 6 provides some common practices used to measure consensus.

Table 6: Methods for consensus measure

Sl No	Method	Description
1	Mean	Can be used for uniform interval/ratio data. Mean ± 0.5 is considered as acceptable range for consensus
2	Standard Deviation (SD)	Measure of mean dispersion
3	Median Score	Measures central tendency of the responses
4	Mode	Represents more than 75% respondents agreed on one point
5	Interquartile Range (IQR)	Absolute value of difference between the 75th percentile and 25th percentile
6	Coefficient of Variance (CV)	Standardised measure of dispersion (standard deviation divided by mean)

The method used in this study for consensus measure is IQR. The use of this method is recommended to tackle the outlier effect and achieve a robust result (Gracht 2012). The IQR is the measure of dispersion of the median, and an IQR value ≤1 indicates that more than 50% of all opinions will fall on one point of the scale. A smaller value of IQR (≤1) indicates a higher degree of agreement.

But the Delphi technique recommends conducting at least two rounds of survey. The method of CV is used in many Delphi studies to compare statements from succeeding rounds. A consistent decrease in the CV value between the rounds indicates an increase in consensus.

5. Methodology

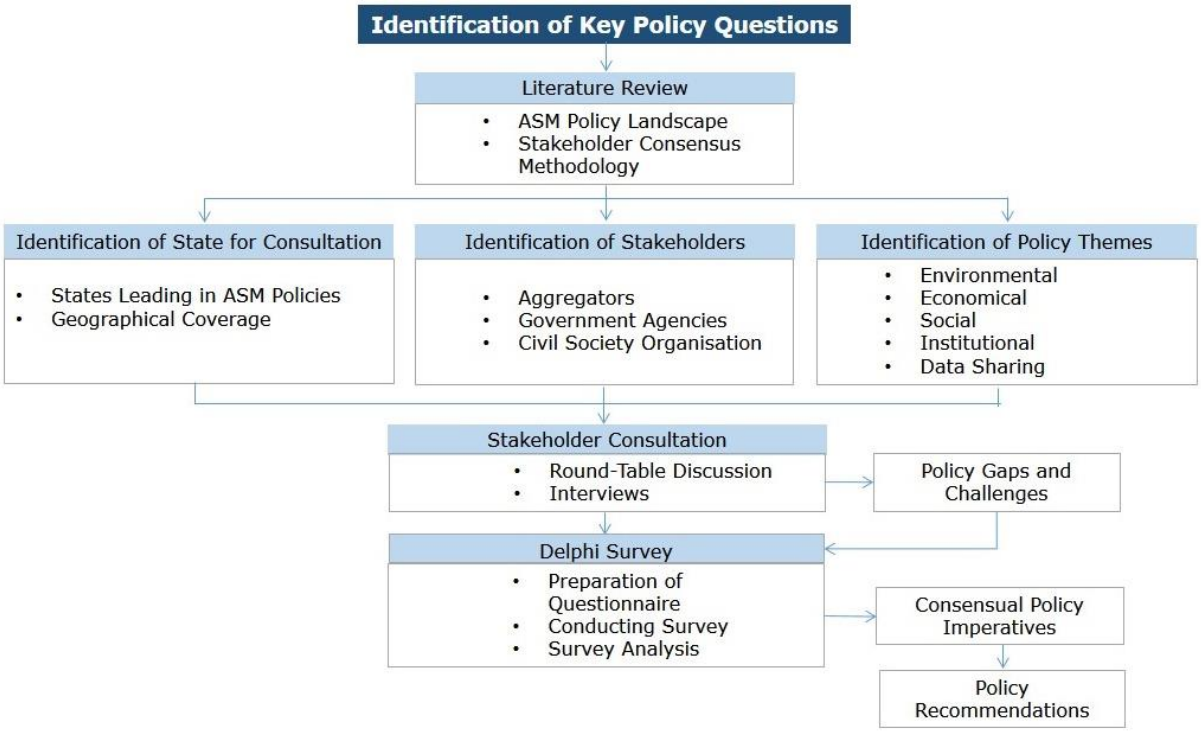

Figure 2: ASM exploratory study methodology flow chart

Figure 2 explains the methodology adopted for the study. While understanding the existing measures to regulate the ASM services and identifying the policy gaps, it was deemed necessary to categorise the policy questions under various themes that contribute to sustainability. After a thorough literature review and stakeholder consultation, the following themes and the underlying questions relevant to achieving the objectives of the study were identified.

Figure 3: Sustainability Themes

From a large spectrum of people/organisations involved in the ASM operations, central and state government authorities, aggregators and CSOs were identified as stakeholders for this study (Section 6.1).

A round table discussion with aggregators was held, to understand their major concerns and interests related to sustainable urban mobility. The outcomes are detailed in Section 6.1.1.

Following the review of the ASM policies in India, ten states with cab aggregator regulations and five states with bike aggregator regulations were identified (based on notifications available in the public domain). Certain other states are in the process of drafting similar regulations. Among these responsive states, eight geographically dispersed states were selected for personal interviews with the transport stakeholders. The key highlights from the interviews are discussed in Section 6.1.2.

From the review of existing policies and stakeholder interviews, policy issues were identified. Section 7 elaborates on these issues and challenges faced by the ASM ecosystem.

Based on the issues identified from the policy review and stakeholder interviews, Delphi surveys were conducted to collect stakeholder opinions in a quantifiable format. The questionnaire (refer Annexure 1) focused on policy statements based on the abovementioned four sustainability themes. The detailed analysis from this survey is given in Section 8.

6. Stakeholder Consultation

6.1. Identification of Stakeholders

Of the various players involved in the ASM ecosystem, some are influencers, whereas others are influenced by the services. Hence, all those involved in this ecosystem are stakeholders who can be categorised as:

1. Central and state government authorities, who have the control to regulate the operations of these services at the national and state levels. While transport is a state subject, the MoRTH—at the central level—guides the states on how these services can be regulated. The state transport departments then make necessary acts/rules to operate the services. The central- and state-level authorities governing urban development, labour and information technology also play an important role in governing these services.
2. Aggregators, who develop business models to facilitate the link between the drivers/services and commuters. They control the operations and fare of the services and are obliged to adhere to the acts/rules imposed by the state government authorities concerning their operations.

3. Commuters, who use these services to complete their trips seamlessly with ensured comfort and safety. These stakeholders are directly influenced by the services. While the introduction of ASM has improved their commute, affordability and safety have been their major concerns.
4. Drivers/fleet owners, who are the actual service providers. In India, they are categorised as individual contractors rather than employees of the aggregators. When the aggregator gets a request for a trip by the commuter, all drivers in the proximity are alerted to accept the request. The drivers have the freedom to either accept or decline the request.
5. Vehicle manufacturers and technology developers who from time to time innovate new technologies to enable shared mobility. Though these stakeholders do not have a direct influence over the services provided, they ensure comfort and safety through design improvements.
6. Civil society organisations (CSOs) or academicians, who are conducting studies in this sphere, majorly concerning the interests of the commuters and drivers. For the sake of this study, CSOs that are performing such studies are considered representatives of the commuters and drivers.

In-depth interactions were carried out primarily with two sets of stakeholders—government officials and cab aggregators. A round table discussion was organised for the cab aggregators, whereas face-to-face interviews were conducted with government officials.

Cab Aggregators Round Table Discussion

The round table saw participation from Ola, Ola Mobility Institute, Bounce, Quick Ride, Vogo, Uber, Yulu, RedBus and Shuttl. The discussion was conducted in five sessions, each steering around a sustainability theme. From the discussion, it was apparent that ease of operations, multimodality, passenger safety and revision of the existing policies were the main concerns of the participants. Detailed discussions from this round table are mentioned in Annexure 4. The key discussion points have been compiled below.

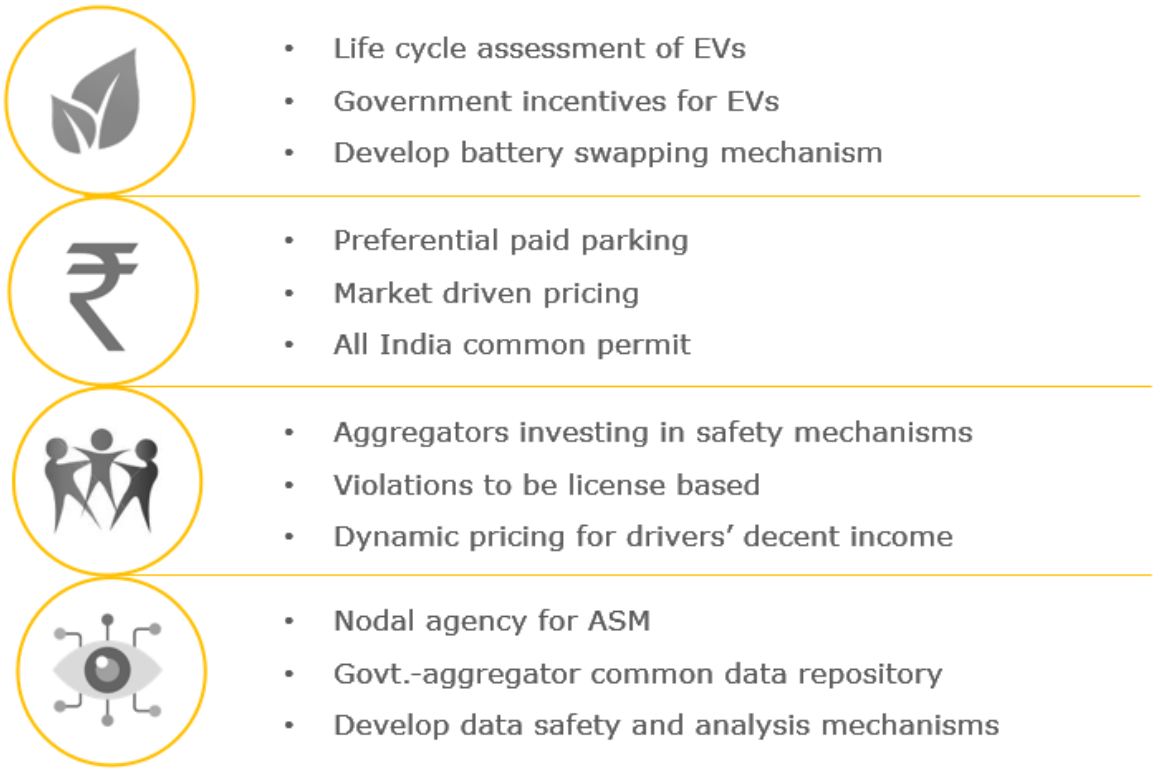

Figure 4: Key points from aggregators' round table

Government Stakeholder Interviews

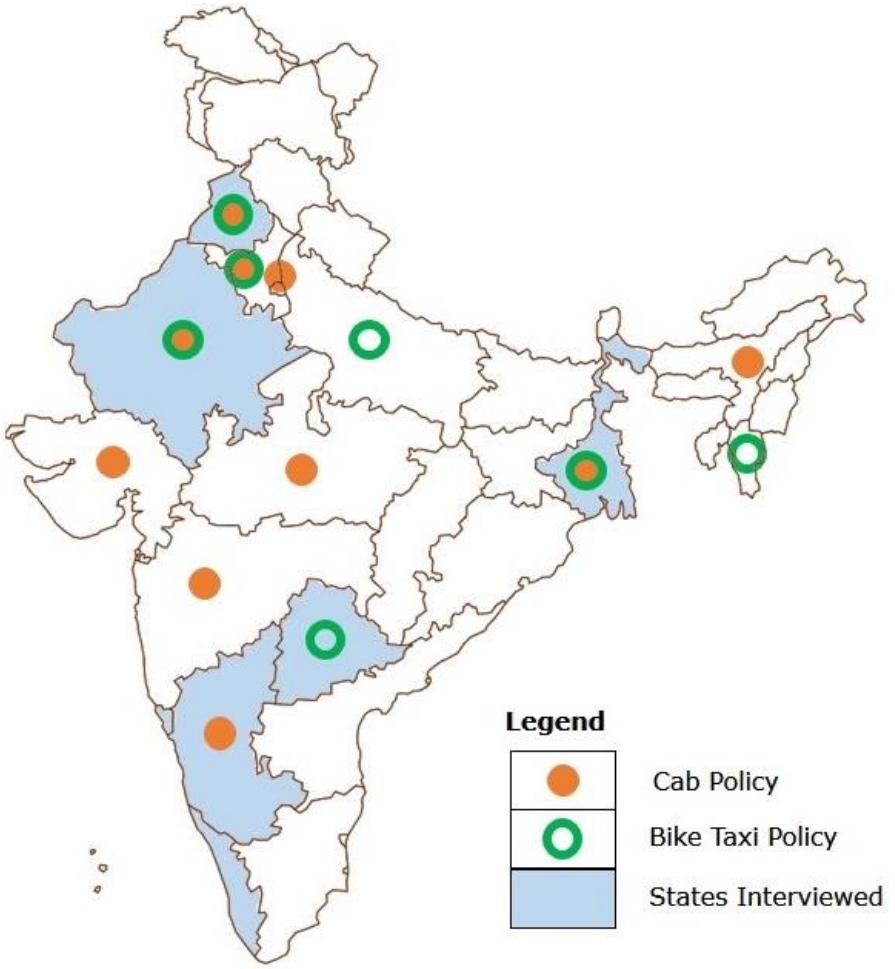

Figure 5: Map showing state-wise policy coverage

Interviews were conducted with eight states having cab aggregator policies. The interactions show that most states consider the ecosystem as a means of empowering the commuters with an array of travel options to choose from while also providing employment to skilled youth. Some states also believe ASM could be a channel to promote clean vehicle technologies[10] (CVTs). Though states have different mobility goals and priorities, all transport authorities are equally interested in efficiently regulating the ASM services without hampering the choices of the commuters and operations of the existing public transport services.

[10] Clean Vehicle Technology refers to electric vehicles throughout this study.

Delhi

- Willing to provide a wide range of commuting choices
- No control on taxi registrations; auto registrations capped at 1 lakh

Goa

- Government operates app-based taxies on fixed rates
- No pooled rides owing to safety reasons

Karnataka

- Proactive in regulating and encouraging ASM
- Electric vehicles under consideration for ASM

Kerala

- Promoting ASM for multimodal connectivity
- Focus on 2- and 3-wheelers in ASM for electrification

Punjab

- Promoting ASM for employment generation
- Draft policy for ASM services

Rajasthan

- Promoting ASM for seamless connectivity, with focus on physical and institutional integration

Telangana

- Open market for ASM in terms of vehicle numbers and fares
- State police app launched for women safety

West Bengal

- Promoting ASM to decrease private vehicle ownership
- Government ASM service to regulate market inequalities

Kochi Metro

- UMTA for multimodal integration
- Dedicated parking and charging at Metro stations for e-rickshaws

Hyderabad Metro

- Partnering with ASM for first- and last-mile connectivity
- Plan to promote e-rickshaws

Jaipur Metro

- Promoting ASM and e-rickshaws for first- and last-mile connectivity
- Plans to collect O-D data from aggregators

Figure 6: Summary of government stakeholder discussions

Table 7: Theme-wise government action plans

States	Themes				
	Environmental	Economic	Social	Institutional	Data Sharing
Delhi	●	●	●	○	●
Goa	●	●	●	●	●
Karnataka	●	○	●	●	●
Kerala	●	●	●	●	●
Punjab	●	○	●	○	○
Rajasthan	●	●	●	●	●
Telangana	●	●	●	○	●
West Bengal	●	●	●	●	●

Legend: ● Action initiated ● Action under consideration ● No action considered ○ No mention

The table above summarises the status of the interviewed state transport authorities in implementing measures to achieve sustainability through the ASM ecosystem. With most states acting on passenger safety issues, social sustainability is clearly in focus. Most transport authorities are working towards multimodal integration with the ASM services to ensure that all services are economically sustainable while providing seamless transport to commuters. States like Punjab are also promoting ASM with a specific economic development objective in mind—employment generation which also reflects as social appraisal. While most authorities are concerned about the governance of these new services, very few have taken actions to strictly regulate them. It can be observed that very few states are proactive in controlling the emissions and promoting CVTs for environmental sustainability. Though ASM policies mandate sharing data when necessary, very few states have acquired this data.

7. Policy Issues and Challenges

Based on the literature review and the stakeholder engagements, the following issues and challenges within the ASM policy landscape were identified.

1. Carpooling/Ride Pooling: According to a WRI report, approximately 25,000 daily trips in Delhi were carpooled in 2017. This increased by 25% during the odd–even rule in April 2016 (Dey and Chadha 2017). Though this number is just 0.1% of the total trips in Delhi (total daily trips in Delhi are ~200 lakh) (Rites 2010), it can exponentially increase if carpooling is regularised. However, most states have not regularised private carpooling, and a few have banned the operations of ride-pooling services. The ban is related to the contract carriage permit given to the commercial vehicles that does not allow multiple stops and accommodating strangers in a single ride. Similarly, there are no specific permits that allow private car users to share their rides. Such ambiguities hinder these services which are effective in increasing vehicle occupancy, thereby reducing congestion and pollution. However, in the absence of relevant policies or regulations, the safety of these services remains a concern.
2. Electric Mobility: Even as electric mobility is becoming an integral part of Indian transport system, there is uncertainty regarding their registration and licensing. While few cities encourage electric vehicles in ASM, some cities have no such plans in the near future. In Indian metro cities, the total number of cabs might be 10% of that of the private cars, but their average daily run is much higher—almost 1.5 times that of the total private cars (*The Economic Times* 2018). Thus, cabs can prove to be a good start for four-wheeler electrification in urban India.
3. Data Sharing: The data collected by the operators can help the city authorities understand travel demand, improve existing transportation systems, ensure passenger safety and monitor aggregator operations. It is essential that the agencies collect data in formats that can be efficiently analysed and reported. Though most of the existing regulations mandate collection and storing of the trip details, there are no rules governing how this data shall be shared with the authorities and how privacy and data security shall be taken care of. Apart from this, there is a lacuna in the expertise of the transport authorities to collect and handle big data. This is a major bottleneck in efficient data sharing from operators. Also, most authorities are not abreast with the technological advancements, curbing their incorporation into the policy measures.
4. Incentives and Encouragement for Multimodality: Few Metro agencies have taken a step forward to partner with ASM for first- and last-mile connectivity, yet there are hardly any policies to incentivise and regularise ASM for such services. There are no provisions for dedicated parking, pick-up and drop-off points at major activity centres and transit

stations for vehicles on ASM. These may be critical in addressing the issue of on-street parking. Formation of such policies would greatly help in promoting multimodality and increase PT ridership in Indian cities. There is also a lack of institutional integration to allocate the revenue collected from aggregator licences for improvement of transportation infrastructure and multimodality.

5. Regulating Bike Taxis: Bike taxis are quick and comfortable commuting options for short trips but pose concerns over permits, safety and insurance. States like Haryana, West Bengal, Rajasthan, Punjab and Telangana have incorporated this form of ASM in their regulations, and the process is underway in states like Karnataka, Kerala and Tamil Nadu, However, most states have left them in the grey area. Bike taxis can act as efficient feeders for metro (0–3 km from the station, i.e., short trips). With proper regulation, they have the potential to significantly reduce traffic congestion. In the case of Bengaluru, 35–40% access and egress trips to and from Metro stations are of a maximum of 3 km distance. People tend to use cabs for this commute, primarily because of the lack of parking space at Metro stations. Regulating bike taxis can convert a majority of these trips to bike trips, increasing vehicle efficiency and reducing traffic congestion.
6. Regulating Bus Aggregators: Most cities like Hyderabad, Kolkata, Delhi and Mumbai are being served by bus aggregators, while the regulations to govern them are still under consideration. As of 2015, app-based bus aggregators Ola and Shuttl had 500 (Pai 2015) and 700 (Kashyaap 2018) buses, respectively, running in different cities of India. This service can complement the state transport undertakings by serving on high-priority routes, feeders to the main transport network (trunk routes and metro service), and underserved areas. These services are demand-based and have a capacity to modify the routes based on daily demand, thus catering to the city dynamics. The government has banned these services stating that these are contract carriages and not allowed to have multiple stoppages. These operations need to be governed in terms of licence permits, fare regulations, area of operation, safety, etc.

After analysing the existing policy gaps from the literature review and stakeholder discussions, a need was felt to understand the consensus amongst the stakeholders on the existing policies and challenges in the ecosystem.

8. Delphi Survey Analysis

Based on the stakeholder consultations, a web-based questionnaire for the Delphi survey was framed. It focused on articulating key policy questions for ASM under the four sustainability themes mentioned previously. For each theme, key policy statements and probable constraints for the ASM ecosystem in attaining sustainability were listed. The experts were asked to rate their responses on a five-point Likert scale. They also had an option to suggest additional policies or constraints not included in the questionnaire.

The survey targeted three set of experts:

1. Operators/Entrepreneurs (cab/taxi aggregators)
2. Government officials (Centre/state transport departments)
3. Civil society organisations (experts working on shared mobility)

To prevent a misleading consensus, experts were shortlisted from multidisciplinary sectors, comprising government decision makers, academicians, urban planners, aggregators/ operators, etc. Survey forms were shared with these experts via email for their responses.

8.1. Delphi Survey Round 1

For Delphi survey Round 1, a total of 39 statements (26 policy statements and 13 constraints) were formulated.

The consensus was measured using different methods (refer Annexure 2). As mentioned earlier, the IQR method was used to arrive at the consensus measure for this round. As per the IQR criteria, 14 policy statements and 6 constraints reached consensus. Out of these 14 policy statements, 8 were highly agreed upon (median score 5[11]), 5 were moderately agreed upon (median score 4) and 1 was neutral (median score 3). Likewise, of the 6 constraints, 1 was highly agreed upon and the rest 5 were moderately agreed upon.

The summary of results from Delphi survey Round 1 is shown in Figure 6, and the summary of policy statements and constraints reaching consensus under each theme is given in Table 8. Detailed theme-wise analysis is given in Annexure 2.

[11] Median score: 5 (Strongly agree), 4 (Agree), 3 (Neutral), 2 (Disagree), 1 (Strongly disagree)

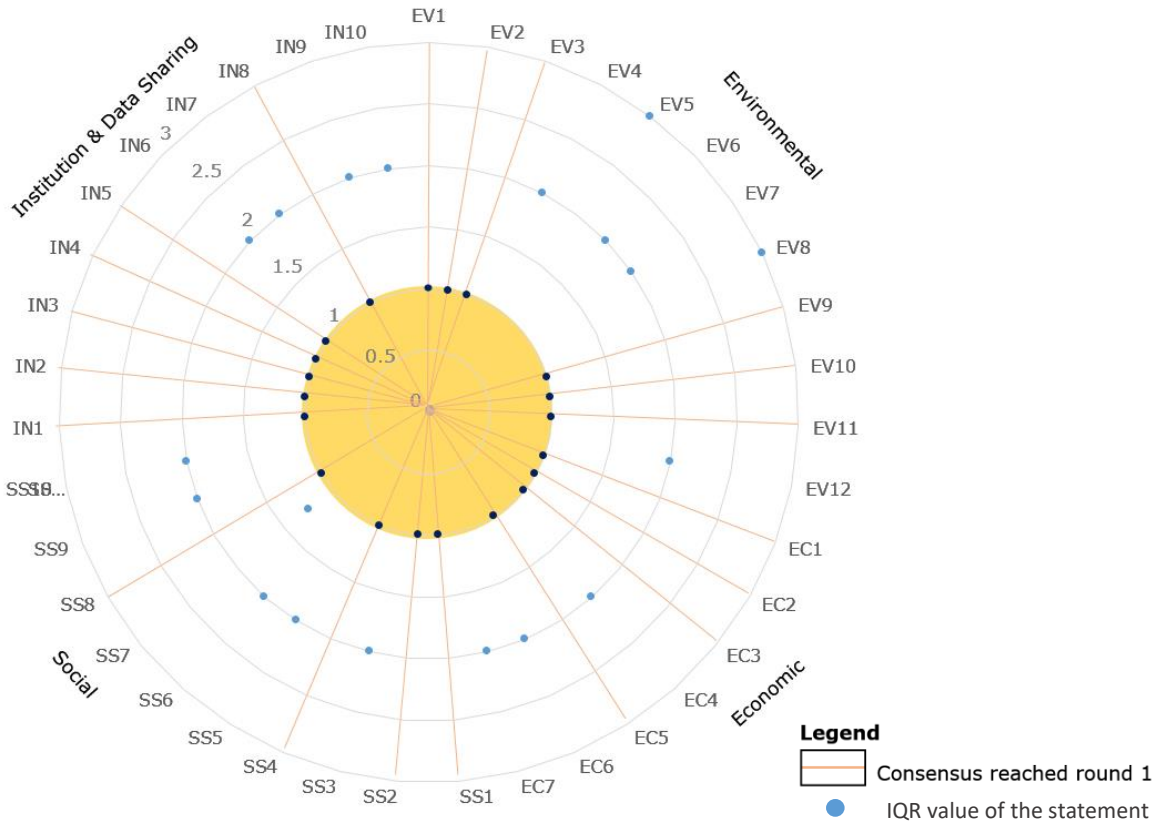

Figure 7: Delphi survey round 1 results

Table 8: Summary of Delphi survey Round 1 results: Statements that reached consensus

	Legend	Policy/Constraints
Environmental Sustainability	**Policies**	
	EV1	Incentivising shared rides
	EV2	Government authorities promoting CVTs
	EV3	Manufacturers adopting CVTs
	Constraints	
	EV9	Lack of physical infrastructure for adoption of CVTs
	EV10	Lack of mechanisms to dispose of electric batteries
	EV11	Lack of mass transit options
Economic Sustainability	**Policies**	
	EC1	Integrating ASM services with PT for first- and last-mile connectivity
	EC2	Preferential paid parking for ASM at important activity centres
	EC3	Legalising peer-to-peer carpooling to promote shared mobility
	Constraints	
	EC5	Lack of studies to understand implication of the ASM ecosystem on mobility
	Policies	
So cia	SS1	Sharing of real-time vehicle movement data to ensure passenger safety

	SS2	Fair pricing mechanism to ensure affordability of ASM services
	SS4	Violations being licence-based, rather than vehicle-based
	Constraints	
	SS8	Low profits for ASM operators in underserved areas
Institutional Sustainability and Data	**Policies**	
	IN1	Amending regulations and acts with technological advancement
	IN2	Establishing a common central agency to regulate the ASM ecosystem
	IN3	Two-way data sharing between government and aggregators
	IN4	Designing guidelines for data sharing
	IN5	Capacity building for government bodies to analyse ASM data
	Constraints	
	IN8	Lack of an institutional setup to mobilise funds for transport infrastructure development

8.2. Delphi Survey Round 2

After analysing the results from Delphi survey Round 1, it was observed that 17 statements (11 policy statements, 6 constraints) did not reach consensus. A second round of survey was conducted for these statements to seek further opinion from the experts on their rating and to finalise the consensual policy imperatives and major constraints. The questionnaire was sent to the same experts who participated in the Round 1 survey. The response rate for this round was very less.

The consensus measure criteria opted in Round 2 was thus: IQR value ≤ 1, and CV (Round 2) should be less than CV (Round 1). The results of Round 2 showed that two policy imperatives and three constraints reached consensus. The statements that reached consensus are given in Table 12 (Annexure 3).

Policy imperatives:

1. Levying emission taxes on ASM services (EV8)
2. Incentivising ASM services operating in underserved areas (SS7)

Constraints:

1. Inertia towards adopting new technologies (EC7)
2. Poor adherence to the existing safety norms (SS9)
3. Lack of close collaboration between operators and government bodies to integrate the ASM services (IN9)

Figure 8 represents the consensus level in Round 2. The detailed results are given in Annexure 3.

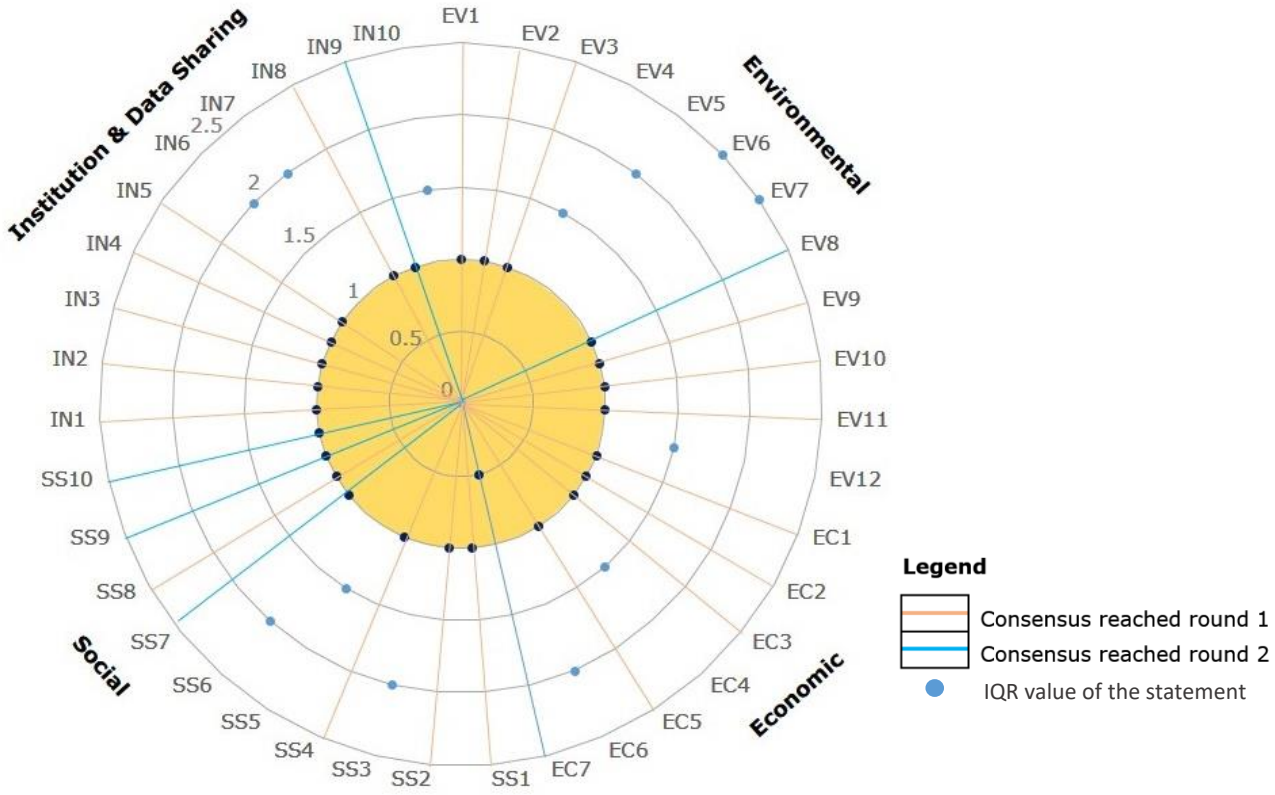

Figure 8: Delphi survey round 2 results

8.3. Stakeholder-wise Delphi Survey Analysis

A stakeholder-wise Delphi survey analysis was carried out separately to understand the opinion of each set of stakeholders independently. Table 9 shows a summary of the consensus results. It shows that out of 39 statements, government stakeholders reached consensus on 22 statements (17 policy imperatives and 5 constraints), aggregators/operators reached consensus on 16 statements (12 policy imperatives and 4 constraints) and CSOs reached consensus on 26 statements (16 policy imperatives and 10 constraints). For government stakeholders, based on the consensus level, social (8 out of 10 statements reached consensus) and institutional sustainability (6 out of 10) seems to be highly important. For CSOs, economic (6 out of 7) and social sustainability (9 out of 10) seems to be of utmost priority. Likewise, operators agreed more on economic sustainability (5 out of 7). Also, very few statements reached consensus under social sustainability (1 of 10).

Table 9: Summary of statements that reached consensus

Policy Themes	**Total Policy Statements**	**Number of Statements That Reached Consensus for Each Group**		
		Government	Operators	CSOs
Total	39	22	16	26
Environmental Sustainability	12	5	5	4
Economic Sustainability	7	3	5	6
Social Sustainability	10	8	1	9
Institutional Sustainability and Data Sharing	10	6	5	5

8.4. Consensual Policy Imperatives

The survey revealed that the following policy imperatives were agreed upon by all the stakeholder groups:

High-Consent Policies

These are policies that the stakeholders have strongly agreed upon as essential to attain sustainability:

1. Incentivising shared rides
2. Integrating ASM services with PT for first- and last-mile connectivity
3. Legalising peer-to-peer carpooling to promote shared mobility
4. Sharing of real-time vehicle movement data to ensure passenger safety
5. Amending regulations and acts with technological advancement
6. Two-way data sharing between government and aggregators
7. Designing guidelines for data sharing
8. Capacity building for government bodies to analyse ASM data

Moderate-Consent Policies

Policy statements:

1. Government authorities promoting CVTs
2. Preferential paid parking for ASM at important activity centres
3. Violations being licence-based, rather than vehicle-based
4. Fair pricing mechanism to ensure affordability of ASM services
5. Establishing a common central agency to regulate the ASM ecosystem

Constraints:

1. Lack of physical infrastructure for adoption of CVTs
2. Lack of mechanisms to dispose of electric batteries
3. Lack of mass transit options
4. Lack of studies to understand implications of the ASM ecosystem on mobility
5. Insufficient land for dedicated parking at major activity centres
6. Low profits for ASM operators in underserved areas
7. Lack of an institutional setup to mobilise funds for transport infrastructure development

A comparison table for existing policy, consensus and CO_2 mitigation potential is given in Section 9.

8.5. Non-consensual Policy Imperatives

The following policy statements have the potential to mitigate CO_2 emissions from ASM even though there was no consensus:

- Incentivising fleet operators willing to shift to CVTs
- Levying congestion pricing on ASM services in central business districts (CBDs) and PT corridors
- Taxing and capping vehicle kilometres travelled (VKT) by ASM services
- Taxing low-occupancy rides

Similarly, though not consensual to all, privacy and security of the shared data is a constraint hindering these operations' contribution to sustainable mobility.

9. Decision Matrix for the Sustainability Themes

A decision matrix, as shown below, was considered to identify the important policy statements which have the potential to mitigate CO_2 emissions from ASM even though there was no consensus. The policy statements under each theme were evaluated based on policy action (Present/Absent), consensus measure (Yes/No) and CO_2 mitigation potential (Positive/Negative/None/Don't know) criteria. It was found that of the 26 policy statements, 12 statements (EV1–EV8, EC2, EC4, SS7 and IN2) have the highest potential to mitigate CO_2 emissions. Out of the 12 statements, 7 statements (EV1, EV2, EV3, EV8, EC2, SS7 and IN2) have reached consensus. Of the 7 statements, there is an existing policy for 2 statements (EV1 and EV2), and 5 statements (EV3, EV8, EC2, SS7 and IN2) do not have a policy; hence, these policies also need to be prioritised by the states to mitigate CO_2 emissions from ASM.

Table 10: Decision matrix for the sustainability themes

Legend	Policies/Constraints	Policy Action	Consensus	CO_2 Mitigation Potential
Environmental Sustainability				
EV1	Incentivising shared rides	Absent	Yes	Positive
EV2	Government authorities promoting CVTs	Present	Yes	Positive
EV3	Manufacturers adopting CVTs	Present	Yes	Positive
EV4	Incentivising fleet operators willing to shift to CVTs	Absent	No	Positive
EV5	Levying congestion pricing on ASM services in central business districts (CBDs) and PT corridors	Absent	No	Positive
EV6	Taxing and capping vehicle kilometres travelled (VKT) by ASM services	Absent	No	Positive
EV7	Taxing low-occupancy rides	Absent	No	Positive
EV8	Levying emission taxes on ASM services	Absent	Yes	Positive
Economic Sustainability				
EC1	Integrating ASM services with PT for first- and last-mile connectivity	Present	Yes	Positive
EC2	Preferential paid parking for ASM at important activity centres	Absent	Yes	Positive
EC3	Legalising peer-to-peer carpooling to promote shared mobility	Absent	Yes	Don't know
EC4	Market-driven pricing with no fare regulations for ASM	Absent	No	Positive

Social Sustainability				
SS1	Sharing of real-time vehicle movement data to ensure passenger safety	Present	Yes	None
SS2	Fair pricing mechanism to ensure affordability of ASM services	Present	Yes	Negative
SS3	Making licence data public for the verification of self-drive vehicle users	Absent	No	None
SS4	Violations being licence-based, rather than vehicle-based	Absent	Yes	None
SS5	Considering drivers as entrepreneurs	Absent	No	None
SS6	Capping drivers' working hours	Present	No	Negative
SS7	Incentivising ASM services operating in underserved areas	Absent	Yes	Positive
Institutional Sustainability and Data Sharing				
IN1	Amending regulations and acts with technological advancement	Absent	Yes	Positive
IN2	Establishing a common central agency to regulate the ASM ecosystem	Absent	Yes	Positive
IN3	Two-way data sharing between government and aggregators	Absent	Yes	None
IN4	Designing guidelines for data sharing	Absent	Yes	None
IN5	Capacity building for government bodies to analyse ASM data	Absent	Yes	None
IN6	Need for a national-level permit for the ASM vehicles	Absent	No	Don't know
IN7	Mandating Aadhar card verification for licence and registration of ASM vehicles	Present	No	None

10. Conclusion and Recommendations

10.1. Conclusion

After a review of the existing policies and stakeholder consultations, we identified the policy gaps in the ASM ecosystem and constraints on achieving sustainability through ASM.

The aggregators highlighted the need for collaboration between operators and government bodies to integrate the ASM services, ensure passenger safety, and avoid traffic violations.

The findings from the Delphi survey indicate that of the 39 statements (policies and constraints) considered as part of the survey questionnaire, there is consensus on 16 policy statements and 9 constraints.

The findings from the decision matrix indicate that 12 policy statements have the highest potential to mitigate CO_2 emissions. Of the 12 policy statements, 7 statements reached consensus and there is policy only for only 2 statements. Even though the remaining 5 statements have the potential to mitigate CO_2 emissions, there is no policy relating to them yet. Hence, there is a need for states to prioritise these policies to mitigate CO_2 emissions from ASM.

10.2. Recommendations

The study recommends important policies that can help achieve sustainability through ASM, including incentivising high-occupancy rides and CVTs, regularising peer-to-peer carpooling, enhancing passenger safety, amending existing regulations to rightly recognise the ASM services, and facilitating data-sharing mechanisms.

Promotion of Clean Vehicle Technologies (CVTs)

Several ASM service providers are willing to adopt cleaner fleets with the help of incentives. The government shall undertake and strategise on the adoption of various CVTs by the shared-mobility ecosystem. This could be done through monetary incentives or operational benefits like dedicated parking lots and easier licensing processes. The aggregators may consider collaborating with manufacturers to explore financial viability. Simultaneously, infrastructure to support new vehicles needs to be developed to enable the adoption. In the case of electric vehicles, proper means for battery replacement/resale and disposal should be considered. As electric vehicles have zero tail-pipe emissions, and the number of ASM vehicles is increasing at a very fast pace, the adoption of CVTs may remarkably reduce the urban-mobility carbon footprint.

Enhancement of Multimodality

The state transport departments shall focus on multimodal integration for PT to be complemented by the ASM services. As already implemented in some states, like Kerala, the transport authorities can collaborate with ASM service providers for first- and last-mile connectivity. This can be enabled by providing dedicated parking bays in transit stations and

major activity areas, integrating the fare systems or incentivising the last-mile connectivity from PT. This will encourage people to use PT, thereby reducing on-road vehicles and consequently their emissions.

Incentivising Pooled Rides

Understanding the importance of high-occupancy rides in reducing congestion and air pollution, the authorities shall regularise and incentivise the operations of the ride-pooling services. In a similar context, carpooling services enabling private commuters to offer rides shall also be legalised to attain the potential of pooled rides. As these rides pose concerns of safety, specific measures to ensure safety of the commuters need to be focused on.

Regulations and Amendments

During the study, it was observed that the ASM services are being regulated by modifying existing regulations such as the MV Act. These regulations do not address or comply with the technological developments and pose policy gaps. Regulations need to be devised to govern the new technologies to incorporate further developments as well. Policy gaps and the unclear nature of regulations act as constraints on the adoption of ASM services.

As bike taxis and bus aggregators are already operational in a few states, a common set of guidelines at the national/state levels needs to be formed.

Regulation on Fares

Though dynamic pricing is essential to ensure service supply as required, a control on how and when the surge pricing is applied is essential to ensure affordability of the services.

Accessing Licence Data

The individual licence data and validity details shall be made accessible to the ASM service providers. This can ease the background check of the drivers associated with them and the commuters availing vehicle-sharing services. This validation helps avoid violations and track the violators.

Control on Violations

Violations are often associated with the vehicle owner rather than the vehicle user. In this sharing ecosystem where the violators are not necessarily the owners, such regulations hamper operations. The traffic authorities should formulate means wherein the actual violators are penalised. This can be identified if the licence data is made available to the service providers.

Data Sharing and Capacity Building

The transport authorities should consider using ASM data for decision-making in day-to-day traffic operations (planning for kerb-side pick/drop points, identifying low-speed corridors, etc.)

and achieving city-specific urban-mobility goals. Given the specific goals, the authorities shall mandate service providers to share the data (trip details, travel pattern, vehicle movement, driver details, etc.) in the required format. This requires capacity building for the officials to analyse the data shared. Proper rules to maintain data privacy shall also be formulated and strictly adhered to.

Nodal Regulating Agency

To enforce these measures, institutional sustainability is important. A regulatory authority like UMTA shall be constituted to integrate services, recommend amendments to regulations, and provide solutions for forthcoming issues within the ecosystem.

10.3. Way Forward

Going forward, shared rides need to be encouraged in all the states as they can contribute to reduction in congestion and improvement in air quality. The decision matrix proposed by the study can serve as a guideline for the states to formulate policies that help mitigate the CO_2 emissions from urban mobility. The states also need to proactively develop new mobility policies in line with technological innovations. Other policies addressing commuter safety, driver welfare, and data security also need to be prioritised. Further studies are needed to understand the impact of shared mobility on environment, PT, vehicle ownership, societal cost, fleet size, labour, equity and infrastructure, among others.

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Annexure 1

Delphi Survey Questionnaire

Center for Study of Science, Technology and Policy (CSTEP) is conducting an exploratory study on App-Based Shared Mobility (ASM). As part of the study, this survey focuses on articulating ASM key policy questions under four sustainability themes: environmental, economic, social and institutional. For each theme, selected key policies and the probable constraints to achieve the sustainability goals have been listed.

Email address (Optional): _____

Environmental Sustainability

The following policy imperatives can help achieve environmental sustainability through the App-Based Shared Mobility (ASM) ecosystem.

Rate these statements on the Likert Scale.

Policy Imperatives	Ranking				
	SD[12]	D[13]	N[14]	A[15]	SA[16]
Government authorities promote CVTs					
Manufacturers adopt CVTs					
Incentivising fleet operators willing to shift to clean vehicle technologies					
Levying congestion pricing on ASM services in central business districts (CBDs) and PT corridors					
Taxing and capping vehicle kilometres travelled (VKT) by ASM services					
Taxing low-occupancy rides					
Incentivising shared rides					
Levying emission taxes on ASM services					
Please recommend additional policies, if any:					
Constraints					
Lack of physical infrastructure for adoption of new CVTs					
Uncertainty regarding the impact of new vehicle technologies on ASM services					
Lack of mechanisms to dispose of electric batteries					
Lack of mass transit options					
Please mention additional constraints you have observed, if any:					

Economic Sustainability

[12] SD: Strongly Disagree
[13] D: Disagree
[14] N: Neutral
[15] A: Agree
[16] SA: Strongly Agree

The following policy imperatives can help achieve economic sustainability through the App-Based Shared Mobility (ASM) ecosystem.

Rate these statements on the Likert Scale.

Policy Imperatives	Ranking				
	SD	D	N	A	SA
Market-driven pricing with no fare regulations for ASM					
Integrating ASM services with PT for first- and last-mile connectivity					
Preferential paid parking for ASM at important activity centres					
Legalising peer-to-peer carpooling to promote shared mobility					
Please recommend additional policies, if any:					
Constraints					
Insufficient land for dedicated parking at major activity centres					
Inertia towards adopting new vehicle technologies					
Lack of studies to understand implication of the ASM ecosystem on mobility					
Please mention additional constraints you have observed, if any:					

Social Sustainability

The following policy imperatives can help achieve social sustainability through the App-Based Shared Mobility (ASM) ecosystem.

Rate these statements on the Likert Scale.

Policy Imperatives	Ranking				
	SD	D	N	A	SA
Considering drivers as entrepreneurs					
Capping drivers' working hours					
Fair pricing mechanism to ensure affordability of ASM services					
Making licence data public for the verification of self-drive vehicle users					
Sharing of real-time vehicle movement data to ensure passenger safety					
Violations being licence-based, rather than vehicle-based					
Incentivising ASM services operating in underserved areas					
Please recommend additional policies, if any:					
Constraints					
Low profits for ASM operators in underserved areas					
Poor adherence to the existing safety norms					
Lack of driver-welfare schemes					
Please mention additional constraints you have observed, if any:					

Institutional Sustainability

The following policy imperatives can help achieve institutional sustainability through the App-Based Shared Mobility (ASM) ecosystem.

Rate these statements on the Likert Scale.

Policy Imperatives	Ranking				
	SD	D	N	A	SA
Need for a national-level permit for the ASM vehicles					
Amending regulations and acts with technological advancement					
Establishing a common central agency to regulate the ASM ecosystem					
Mandating Aadhar card verification for licence and registration of ASM vehicles					
Please recommend additional policies, if any:					
Constraints					
Lack of close collaboration between operators and government bodies to integrate the ASM services					
Lack of an institutional setup to mobilise funds for transport infrastructure development					
Please mention additional constraints you have observed, if any:					

Data Sharing

The following policy imperatives can help achieve institutional sustainability through the App-Based Shared Mobility (ASM) ecosystem.

Rate these statements on the Likert Scale.

Policy Imperatives	Ranking				
	SD	D	N	A	SA
Two-way data sharing between government and aggregators					
Designing guidelines for data sharing					
Capacity building for government bodies to analyse ASM data					
Please recommend additional policies, if any:					
Constraints					
Privacy and security of the shared data					
Please mention additional constraints you have observed, if any:					

Annexure 2

Delphi Survey Results (Round 1)

Table 11: Summary of Delphi survey results (Round 1)

Themes	Legend	Policies/Constraints	Consensus Measures		
			Median [17]	IQR [18]	CV
Environmental Sustainability		**Policy Imperatives**			
	EV1	Incentivising shared rides	5	1	0.3
	EV2	Government authorities promoting CVTs	4	1	0.23
	EV3	Manufacturers adopting CVTs	3	1	0.29
	EV4	Incentivising fleet operators willing to shift to CVTs	4	2	0.36
	EV5	Levying congestion pricing on ASM services in central business districts (CBDs) and PT corridors	3	3	0.49
	EV6	Taxing and capping vehicle kilometres travelled (VKT) by ASM services	3	2	0.49
	EV7	Taxing low-occupancy rides	3	2	0.53
	EV8	Levying emission taxes on ASM services	3	3	0.48
		Constraints			
	EV9	Lack of physical infrastructure for adoption of CVTs	5	1	0.26
	EV10	Lack of mechanisms to dispose of electric batteries	4	1	0.26
	EV11	Lack of mass transit options	4	1	0.27
	EV12	Uncertainty regarding the impact of CVTs on ASM services	4	2	0.34
Economic Sustainability		**Policy Imperatives**			
	EC1	Integrating ASM services with PT for first- and last-mile connectivity	5	1	0.16
	EC2	Preferential paid parking for ASM at important activity centres	4	1	0.29
	EC3	Legalising peer-to-peer carpooling to promote shared mobility	5	1	0.17
	EC4	Market-driven pricing with no fare regulations for ASM	3	2	0.41
		Constraints			
	EC5	Lack of studies to understand implication of the ASM ecosystem on mobility	4	1	0.25
	EC6	Insufficient land for dedicated parking at major activity centres	4	2	0.32
	EC7	Inertia towards adopting new technologies	4	2	0.31

[17] Median score: 5 (Strongly agree), 4 (Agree), 3 (Neutral), 2(Disagree), 1(Strongly disagree)
[18] IQR ≤ 1 indicates consensus reached

Social Sustainability		**Policy Imperatives**			
	SS1	Sharing of real-time vehicle movement data to ensure passenger safety	5	1	0.12
	SS2	Fair pricing mechanism to ensure affordability of ASM services	4	1	0.28
	SS3	Making licence data public for the verification of self-drive vehicle users	4	2	0.27
	SS4	Violations being licence-based, rather than vehicle-based	4	1	0.22
	SS5	Considering drivers as entrepreneurs	4	2	0.38
	SS6	Capping drivers' working hours	4	2	0.29
	SS7	Incentivising ASM services operating in underserved areas	4	1.25	0.26
		Constraints			
	SS8	Low profits for ASM operators in underserved areas	4	1	0.23
	SS9	Poor adherence to the existing safety norms	4	2	0.29
	SS10	Lack of driver-welfare schemes	4	2	0.27
Institutional Sustainability and Data Sharing		**Policy Imperatives**			
	IN1	Amending regulations and acts with technological advancement	5	1	0.25
	IN2	Establishing a common central agency to regulate the ASM ecosystem	4	1	0.31
	IN3	Two-way data sharing between government and aggregators	5	1	0.21
	IN4	Designing guidelines for data sharing	5	1	0.12
	IN5	Capacity building for government bodies to analyse ASM data	5	1	0.2
	IN6	Need for a national-level permit for the ASM vehicles	4	2	0.37
	IN7	Mandating Aadhar card verification for licence and registration of ASM vehicles	4	2	0.34
		Constraints			
	IN8	Lack of an institutional setup to mobilise funds for transport infrastructure development	4	1	0.22
	IN9	Lack of close collaboration between operators and government bodies to integrate the ASM services	4	2	0.22
	IN10	Privacy and security of the shared data	5	2	0.29

Environmental Sustainability

The figure below shows the consensus measure for the environmental theme. It shows that a majority of the participants (around 69%) strongly agreed on incentivising shared rides (EV1). Likewise, approximately 48% of the respondents had a neutral opinion on manufacturers adopting CVTs. The detailed results are given in Annexure 2.

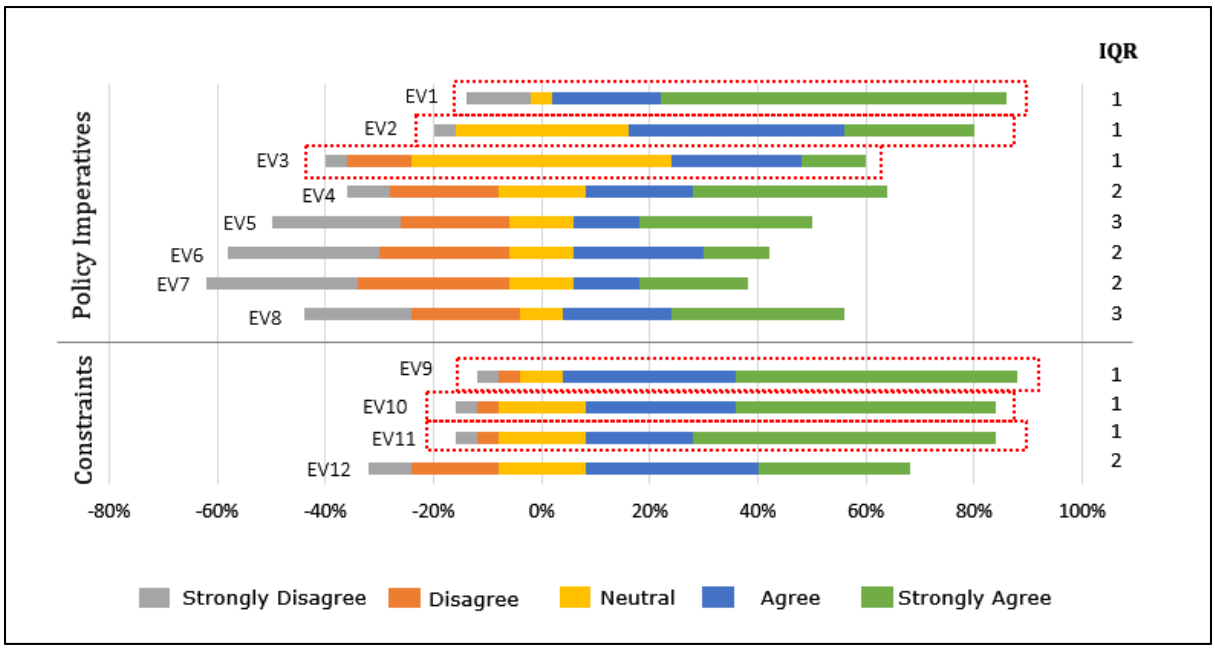

Figure 9: Stakeholder consensus measure for the environmental theme

The policy imperatives that reached a consensus are:

1. Incentivising share rides (EV1)
2. Government shall promote CVTs (EV2)
3. Manufacturers shall adopt CVTs (EV3)

The survey results reveal that incentivising shared rides and government promoting CVTs were highly agreed upon to achieve environment sustainability, but manufacturers adopting CVTs was a neutral point.

The constraints that reached consensus are:

1. Lack of physical infrastructure for adoption of CVTs (EV9)
2. Lack of mechanisms to dispose of electric batteries (EV10)
3. Lack of mass transit options ((EV11)

Of the 4 constraints, 3 reached consensus. The experts strongly agreed that the lack of physical infrastructure for CVTs and lack of integrated mass transit options are major constraints in achieving environment sustainability.

Economic Sustainability

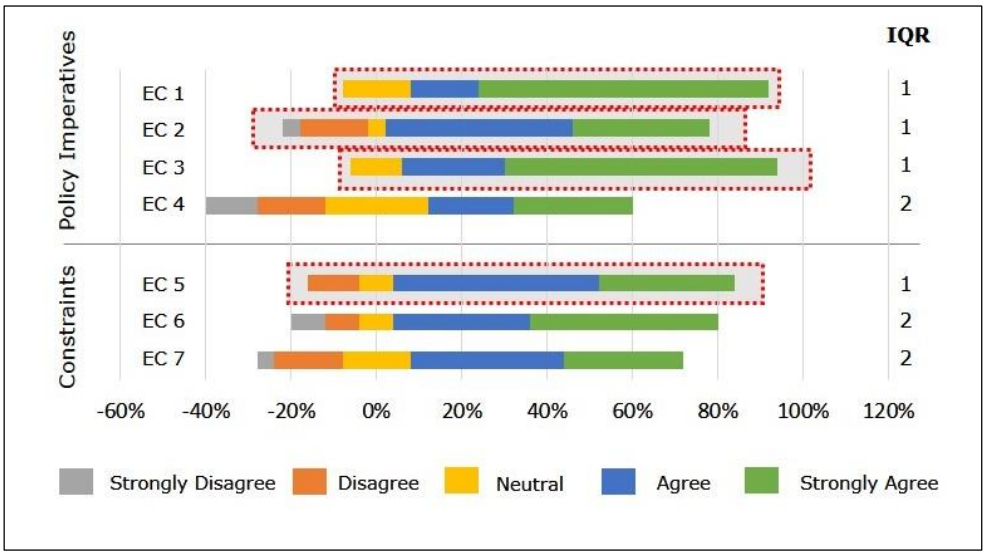

Figure 10: Stakeholder consensus measure for the economic theme

The above figure shows the stakeholder consensus measure for the economic sustainability theme. In this theme, consensus was reached on 3 policy imperatives (of 4) and 3 constraints (of 4). The policy imperatives that reached a consensus are:

1. Integrating ASM services with PT for first- and last-mile connectivity (EC1)
2. Preferential paid parking for ASM at important activity centres (EC2)
3. Legalising peer-to-peer carpooling to promote shared mobility (EC3)

The experts agreed that legalising private carpooling and integrating ASM services with PT for first- and last-mile connectivity are important for achieving economic sustainability. The survey also suggested that the stakeholders encourage preferential paid parking for ASM.

The constraint that reached consensus:

1. Lack of studies to understand implication of the ASM ecosystem on mobility (EC5)

Though legalised parking for ASM services is an important policy, insufficient land for preferential parking at major activity centres is considered as a major constraint.

Social Sustainability

The figure below shows the stakeholder consensus for social sustainability.

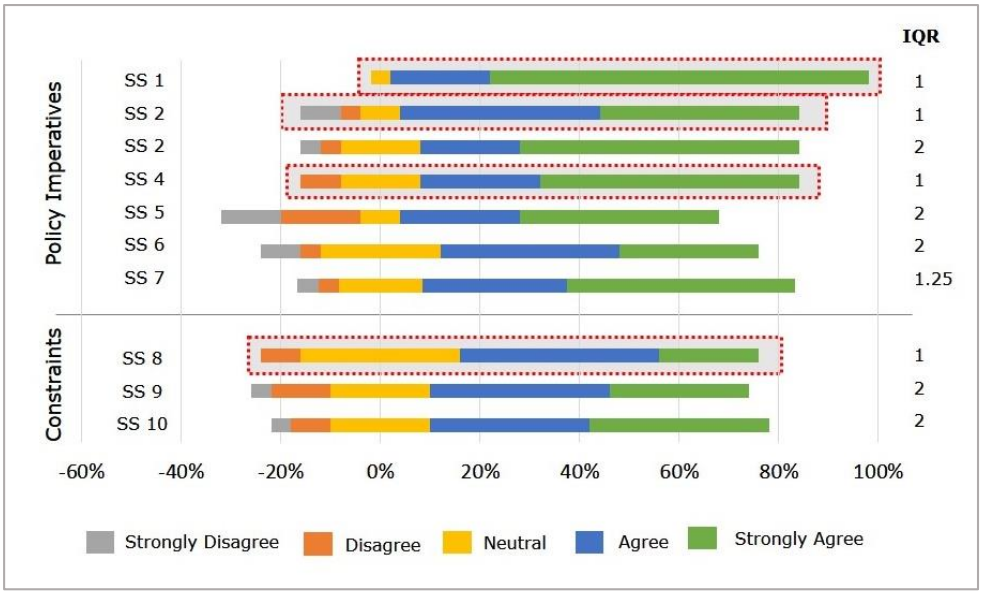

Figure 11: Stakeholder consensus measure for the social theme

The policy imperatives that reached a consensus are:

1. Sharing of real-time vehicle movement data to ensure passenger safety (SS1)
2. Fair pricing mechanism to ensure affordability of ASM services (SS2)
3. Violations being licence-based, rather than vehicle-based (SS4)

For social sustainability, most stakeholders agreed that the policies on real-time vehicle movement and data sharing are essential for commuters' and drivers' safety. To ensure affordability of ASM services, the policy on a fair-pricing mechanism reached consensus. The respondents agreed that recording violations should be licence-based, rather than vehicle-based.

The constraint that reached consensus:

1. Low profits for ASM operators in underserved areas (SS8)

The experts said that a low profit margin for operating in underserved areas is an important constraint. They have varying opinions on driver welfare schemes and poor adherence to existing safety norms.

Institutional and Data Sharing

The figure below shows the stakeholder consensus for institutional and data sharing.

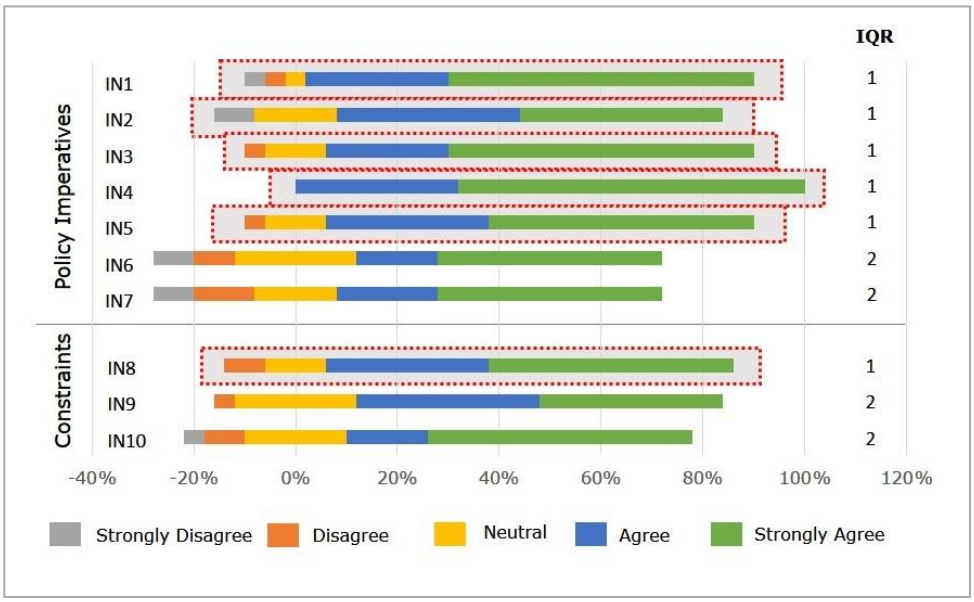

Figure 12: Stakeholder consensus measure for the institutional and data sharing theme

The policy imperatives that reached a consensus are:

1. Amending regulations and acts in line with technological advancement (IN1)
2. Establishing a common central agency to regulate the ASM ecosystem (IN2)
3. Two-way data sharing between government and aggregators (IN3)
4. Designing guidelines for data sharing (IN4)
5. Capacity building for government bodies to analyse ASM data (IN5)

The survey results recommended amending regulations to have a nodal agency for regulating ASM services and amending the existing acts to fit the changing demands. The stakeholders agreed on two-way data sharing and designing guidelines for data sharing to be highly important. Also, a consensus was reached on the fact that government agencies need to build up their capacity to handle and analyse the data shared by the aggregators.

The constraint that reached consensus:

1. Lack of an institutional setup to mobilise funds for transport infrastructure development (IN8)

Of the three constraints, only one reached a consensus. The experts had differing opinions on collaboration between government bodies and operators to integrate ASM services and privacy and security of data.

Annexure 3

Delphi Survey Result (Round 2)

As per the Delphi survey Round 1 results, based on the responses received, 22 statements (of 39) arrived at a consensus. For the remaining 17 statements that did not reach a consensus, Round 2 survey was conducted.

Table 12: Summary of Delphi survey results (Round 2)

Theme	Legend	Policies/Constraints	Median[19]	IQR[20]	CV
	Policies				
Environmental Sustainability	EV4	Incentivising fleet operators willing to shift to CVTs	4	1.5	0.29
	EV5	Levying congestion pricing on ASM services in central business districts (CBDs) and PT corridors	3	2	0.51
	EV6	Taxing and capping vehicle kilometres travelled (VKT) by ASM services	3	2.5	0.51
	EV7	Taxing low-occupancy rides	4	2.5	0.51
	EV8	Levying emission taxes on ASM services	3	1	0.27
	Constraints				
	EV12	Uncertainty regarding the impact of CVTs on ASM services	3	1.5	0.38
Economic Sustainability	**Policies**				
	EC4	Market-driven pricing with no fare regulations for ASM	3	1.5	0.34
	Constraints				
	EC7	Inertia towards adopting new technologies	4	0.5	0.26
Social Sustainability	**Policies**				
	SS5	Considering drivers as entrepreneurs	4	1.5	0.34
	SS6	Capping drivers' working hours	3	2	0.46
	SS7	Incentivising ASM services operating in underserved areas	5	1	0.22
	Constraints				
	SS9	Poor adherence to the existing safety norms	3	1	0.23
	SS10	Lack of driver-welfare schemes	3	1	0.38
Institutional & Data Sharing	**Policies**				
	IN6	Need for a national-level permit for the ASM vehicles	4	2	0.31
	IN7	Mandating Aadhar card verification for licence and registration of ASM vehicles	4	2	0.36
	Constraints				
	IN9	Lack of close collaboration between operators and government bodies to integrate the ASM services	4	1	0.12
	IN10	Privacy and security of the shared data	4	1.5	0.33

[19] Median score: 5 (Strongly agree), 4 (Agree), 3 (Neutral), 2 (Disagree), 1 (Strongly disagree)
[20] IQR ≤ 1 indicates consensus reached

Annexure 4

Summary of the ASM Aggregators Round Table

Environmental Sustainability

This session discussed perspectives related to emissions, congestion, air quality and VKT.

The aggregators were of the opinion that the adoption of electric vehicles should be market driven, and suggested for a proper life cycle assessment (LCA) of electric vehicles before their promotion. To make this transition (conventional vehicles to electric vehicles) smoother, the government should incentivise fleet operators willing to adopt electric vehicles, and also incentivise battery swapping mechanisms at a policy level. There should be a proper battery disposal mechanism to avoid environmental hazards after their life time use. They also suggested that shared mobility will reduce emissions and decongest the city by reducing the number of on-road vehicles (per person per trip).

Economic sustainability

This session discussed perspectives related to operations, pricing strategies, competition and business models.

The aggregators highlighted the need for preferential paid parking for ASM services. This measure can ensure there are no parking violations and generate revenue for government. Also, a market-driven pricing with no fare regulation will ensure supply of drivers to efficiently serve the demand with a right price for their service.

They also highlighted the need for an all-India common travel permit and taxation to allow for commercial vehicles. Similarly, promotion of multimodality by the government would integrate ASM with PT, with the result that these services will complement each other.

There have been initiatives for personal carpooling, but it needs to be regularised in the MV Act, and these types of trips should not be considered as commercial trips; instead, government should provide incentives for carpooling and shared mobility.

Social Sustainability

The third theme was social sustainability, where passenger safety, driver welfare and congestion were discussed.

Customer safety was agreed to be the top priority. Passenger and driver safety are of paramount interest for good quality service. Aggregators informed that the drivers are appointed only after assessment of their driving skills and experience followed by a gender-sensitisation training programme. Aggregators are investing in fraud-prevention systems, real-time modelling, SOS alert to the aggregator call centre and concerned police station, and are partnering with police-related apps to ensure immediate response and customer safety.

The aggregators mentioned that the drivers associated with them are treated as partners and not as employees. The role and liabilities of driver-partners are well articulated to them during the induction itself. This opportunity has uplifted the drivers' social status and increased the skilled workforce in the country. Dynamic pricing with no price regulation will enable the driver-partners to have increased income with lesser working hours. Aggregators provide the driver-partners with flexible working hours.

Institutional Sustainability

Under the institutional sustainability theme, views on regulations, governance structures and capacity building were shared.

The aggregators highlighted the need for a nodal agency for shared mobility regulations and national permit for shared mobility services. They also highlighted the need for state-notified rules for low-powered vehicles under section 75 of the MV Act, amendments in the regulations to adopt technology changes, and clarity on the current taxation law. They also suggested having a carpooling policy at the Centre and sought more clarity on the self-driving car clause under section 66 of the MV Act.

Data Sharing

A data repository with data from the government as well as aggregators needs to be developed to support two-way data sharing. This will be accessible to the concerned stakeholders. Having said this, data safety remains a matter of concern with increasing cybercrime. A proper data safety protection mechanism needs to be implemented to avoid data misuse. Aggregators are willing to share data with authorities, given there is clarity on their goals and the type of data required to achieve them

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