UITP INDIA

SEMINAR REPORT

4th UITP INDIA BUS SEMINAR

24-27 AUGUST 2020 | ONLINE

1 Introduction

India is a developing country experiencing massive growth in its population, with around 35% of the population dwelling in cities. The urban centres in India control a significant share of the Indian economy and new growth opportunities. With this growth, comes a challenge of providing sustainable mobility to its citizens. Bus transportation is the simplest solution for overcoming this problem. It plays an integral role in the socio-economic development of a city by providing affordable transportation means to economic opportunities.

To promote the clean modes of transportation, Government of India launched the FAME I scheme (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India), in 2014, followed by the upgraded FAME II scheme to give a push to electric mobility in the country by providing financial support to stakeholders. In FAME II, around 35% of the electric vehicle subsidy was allocated for the e-buses, showcasing the government support for public transportation. However, to achieve the sustainable bus transport system, there are several hurdles which need to be overcome, such as challenges in procurement, operation, adaptation of new technology, for provision of bus services and many others.

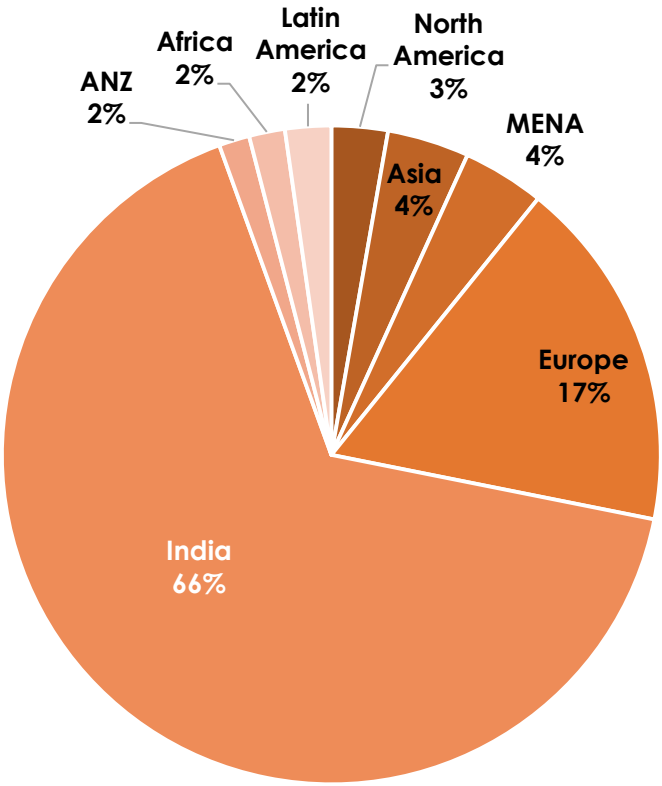
To provide a platform for stakeholder engagement, to share knowledge, and experience, UITP conducted the **4th UITP India Bus Seminar** from 24th – 27th August 2020. The seminar was conducted in partnership with ASRTU (Association for State Road Transport Undertaking) with lead sponsor GIZ India, session sponsors Aum Infotech, Siemens India and Uber, silver sponsor Volvo, and Motorindia as media partner.

This flagship annual event witnessed representation from State Transport Undertakings, private bus operators, financing institutions, ministries involved in bus landscape of India, think tanks, universities, OEMs and other industry players. The seminar encompassed key national and international speakers sharing their knowledge and experiences on various topics viz Covid-19 impact on bus sector and the road to recovery, innovation, digitalisation & artificial intelligence in bus operations, deployment strategies for electric buses and governance & financing instruments to sustain bus operations.

The bus seminar was inaugurated by Honourable Minister of Road Transport & Highways and Minster of Micro, Small and Medium Enterprises, **Shri Nitin Gadkari**, along with **Mr Mohamed Mezghani**, Secretary General, UITP. Mr Mezghani welcomed the participants and conveyed the message about understanding importance of buses in shouldering the covid-19 impact while providing essential services, the economic benefits of buses, and need to move forward to better mobility with innovation, technology, legislative support and safety. In his keynote, Shri Gadkari too emphasised on the need to modernise the public transport fleet and promote the use of green fuels such as bio-CNG, ethanol and methanol while focusing on adopting best financial models for the Indian cities.

The seminar got worldwide recognition with participation from more than 130 companies, 398 registrations from 41 countries with 44% registrations from outside India. The highlight was 40% female speakers present in all the panels. While the seminar was held online due to covid-19 pandemic, it acted as an opportunity for countrywide and worldwide outreach by breaking the barriers of distance.

Figure 1-1 Participant's distributions



2 Impact of covid-19 on the bus operation and the road to recovery

The public transportation usage has seen a decline after the covid-19 world over. Some operators have reported over 80% ridership losses due to a range of factors including government-imposed restrictions and lack of commuter confidence. Such drastic circumstances have severe cost implications on the operators and the transportation agencies. To understand this impact, a plenary session was organised to get a broad understanding in an international case of Victoria, Australia, one State Road Transport Undertaking (SRTU) from the state of Karnataka, one city transport agency (CRUT) for Bhubaneswar city and a private operator from MP group.

The session was an interactive talk on the covid-19 impacts on bus sector and the road to its recovery based on the experience of the panellists. The discussion focused on the impacts on the finances with limited operations and revenue. It also discussed

the impact on patronage with the limited capacity, future outlook and the innovative revenue options. Some of the experience shared is given below.

Victoria, Australia, has about 85 bus operators spread across Metropolitan and regional network, that 125 contracts managed 136 Million service kilometres each year. Typically, the ridership is 65 million riders per year. The ridership has decreased by about 18% in metropolitan bus network, whereas about 22% for the bus network. Bus is a major mode of transportation in Victoria, which means the percentage is significantly high in the regional area. From financial impact, the majority of the bus operators are contracted to the state government. The government decided to not reduce the service payment of the bus contractors during the pandemic and hence the services have not changed.

The bus services were run for a full-time table to serve frontline workers and essential service workers, be it in the health industry or manufacturing industry. Having more services running also ensured that modes competing with the public transport services were also not encouraged. By maintaining the full schedule of services, the operators found their services to be viable during the pandemic. It was also equally important to be flexible with the planning and scheduling so that the services could be responsive and be mobilised quickly to recover back from any changes that may be made. The only restrictions were put up during the night, for night time services following the night curfew. Based on government orders, cleaning of buses was taken up several times a day, and there was a focus on cashless and contactless commute.

Karnataka State Road Transport Corporation or KSRTC has a fleet strength of 8000, with employee strength of around 25,000. From March to May, the KSRTC services were shut down, due to nationwide lockdown. Despite of no operational services, KSRTC managed payment of fixed cost payment including the salaries, rents and the interest on loans from KSRTC internal resources. A major portion of financial support for KSRTC came from the Government of Karnataka, which covered 70% of the salaries of the employees. KSRTC also attempted diversifying revenue generation through new initiatives including the parcel services, goods services, monetisation of land owned by KSRTC. Expenditure on overtime and allowances were reduced. The services were operationalised based on demand.

Karnataka was badly hit by covid-19. From March ridership decreased to the 10% of pre-covid ridership. With reopening of economic activities the ridership in KSRTC buses has increased to approximately 30% of the pre-covid ridership. The operations of AC buses and intercity buses are yet to start. In tier-2 towns, the operations has started but since school and colleges were not open hence the service has a limited patronage. It is being ensured that the seats are rearranged, passenger are limited and social distancing norms are followed. KSRTC hopes to achieve pre-covid-19 ridership by January 2021. KSRTC is also coming up with long- and short-term measures.

MP Group, a private operator of buses in Mumbai, Pune, Amritsar and other cities also shared that the ridership had decreased significantly. The operation of buses currently requires maintaining of social distancing norms. Only 15 people are allowed on a bus,

which is sanitized beforehand and separators have been put up between passengers. The operations during the covid-19 focused more on direct connectivity between two places such as in an Express service. The excess stoppage was discouraged and passengers were requested to leave the seats only when their stops were reached. This approach was taken up in Mumbai and, BRTS Amritsar, and is replicable throughout the country. On the supply side, on behalf of small-scale bus operators, it was expressed that a market consolidation specifically with smaller operators who cannot sustain and the pandemic situation is likely to take place. They may face job loss as well as distress in the market. Even with the management of minimum fixed costs and reduction in expenses, they may find it difficult to sustain. This especially may hamper down the market in the next 6 months. Support from the government is necessary for these types of players.

Bhubaneswar under CRUT has buses operated under the brand of MO buses. CRUT had plans of procuring Electric buses for the first time before the pandemic. 50 buses were ordered through a tender and operations were to start from April but got stalled due to covid-19 induced lockdown. CRUT is also looking forward to innovative solutions using biofuels.

The lockdown time was utilised by training of staff in soft and other necessary skills, which otherwise is difficult for authorities to take up during normal operations. The CRUT bus stops were also temporarily used for alternative activities during the lockdown and hence focus was given on wholesome use of resources and utilisation of time. There was focus on the cleaning of buses with videos of it being uploaded on official social media handles to assure users of the safety measures being undertaken. There was also a constant engagement maintained with the customer through social media asking people the anecdotes of their travel on MO buses, which are later to be converted into a book.

After unlock, strict measures were undertaken with no mask no entry policy. No standing passengers were allowed in buses. The buses are owned and operated by private operators and so cleanliness was already a major part of operations even before covid-19, yet special measures were taken for the same.

3 Innovation, digitalisation and artificial intelligence in bus operations

Adoption of digitalisation is gaining momentum in public transportation. The use of digitalisation in the context of transportation can be explained using four main areas:

- Operational excellence
- Customer excellence
- Engineering excellence

- Safety and security management[1]

In best practices in fare and ticketing the seminar had a Indian case study from Maharashtra State Road Transport Corporation, and international case study from Seoul, South Korea from T Money.

3.1 Best Practices: fare and ticketing

3.1.1 Implementation of digital payments in MSRTC, Maharashtra

MSRTC or the Maharashtra State Road Transport Corporation is a state-run bus transportation agency based in Maharashtra. It holds a fleet of 18,793 buses, with 19,172 routes, 250 depots and more than 100,000 employees. MSRTC has achieved the feat of almost 92% of state coverage with a daily ridership of 6.7 million people, in pre-covid-19 time.

The key initiatives taken by MSRTC for the digital payments include, first, a web-based online reservation system, for booking, seat selection and travel assistance. The second includes Electronic Ticketing Issue Machine (ETIM) system which was installed at all depots leading to reduction in manpower requirement, saving of time required for ticketing, generation of informational MIS reports, accuracy and faster decision making. The third initiative included the Smart Card for availing concessional schemes and cashless travel. This card is an Aadhar based personalised card which included unique architecture with bank shopping wallet, bus corporation's loyalty wallet and pass rules framework, which means that user could use the card at closed-loop transactions on the anchor bus corporation's ETMs and also with all merchants acquired.

The card accounted to 20% of all the transactions, and MSRTC provided 5% bonus on each top-up recharge of this card, where MSRTC received an upfront load income. In addition to the card being available at MSRTC headquarters and stations, it was promoted via 3400+ agents across Maharashtra. Earlier due to manual concessional card verification, the concession provided was misdirected and hence there was a gap in revenue realisation due to it. The smart card thus was issued and it included automatic system authenticated process to streamline the concession. Since the start of the project in June 2019, MSRTC has had 3.66 million registered cards already. Integration of the payments system with existing bus ETIMs made the model more viable for MSRTC. It had deployed a payments system with no upfront CAPEX and OPEX for accepting digital payments. The Smart Card implemented was compatible with the existing EMV Infrastructure and hence no additional infrastructure was required. These smart NFC cards have stored value currency and they are commonly used for packages. Through packages, MSRTC receives substantial turnover and enjoys float income.

[1] Artificial Intelligence (AI) in Mass Public Transport,2017, International Association of Public Transport (UITP) and Land Transport Authority (LTA), https://cms.uitp.org/wp/wp-content/uploads/2020/09/AI_PT_ExecutiveSummary_UITP_APCTE.pdf

The smart card was made easy to issue, load & be used for payments. It's benefits to consumer included real-time payment including encryption technology with high acceptance, unlimited usage, reduced trips to ATMs and safe, as the customer account is never exposed. The benefits to the corporation included a significant reduction in cash handling and unaccounted cash, float income from the sale of bus packages, enhanced customer and brand loyalty, and having a turnkey solution without additional CAPEX, OPEX and disruption to the operational machinery.

3.1.2 Seamless Mobility in South Korea: Tmoney- Integrated ticketing platform

Tmoney is a prepaid card issuer, owner of nation-wide AFC infrastructures and integrated settlement operator for the Seoul Metropolitan Government (SMG).

Tmoney has achieved success in the Automatic Fare Collection (AFC) with success factors such as integrated ticketing platform which can cater to multimodal transport, account-based ticketing, single open payments, link to the bank cards, and operable through mobile phones.

Seoul was assessed as the number one city for public transport efficiency in 2018 by McKinsey. Public transportation in Seoul creates 40 million transactions in a day which are worth 17 million US dollars. The card usage rate in these transactions is 99.1% which accounts to almost all transaction being card-based transaction in the city.

Seoul was a highly congested city until the early 2000s. In 2014, the transportation reforms were brought about and public transportation was given priorities. Buses were given colour coding based on route optimisation, median lanes exclusive for buses were introduced and for the first time in the city, the distance-based fare was brought about which enabled transfer between different types of public transport modes.

The key success factors of the AFC include many cardholders, many places to use and many usages. To have many cardholders, the government encouraged citizens to use smart cards while on public transportation, by providing discount benefits compared to using cash. Secondly from Tmoney, there were consistent efforts to develop new payment medium, so they introduced RF cards, mobile solutions and NFC based payment solutions and others. In terms of numbers, 8.7 million cards a month are being used for public transport which is purely Tmoney cards, plus there are 6.6 million users when it comes to mobile Tmoney membership. Many places to use- include a network of places to use the card for transportation as well as for over 8,000 non-transport retail stores. Regular uses-Tmoney was encouraged amongst users to use on daily basis, for almost cashless transactions by bus and subways benefiting the citizens in transitioning to transportation cards.

Interoperability with Mega City: The single Tmoney card can be used to access all transportation modes, be it rail-based or road-based. It covers multi-operator and multi transportation modes for seamless connectivity. It covers bicycles and parking services as well. Interoperability is achieved with different modes, in the city where the population is 10 million and more, with an infrastructure of 9,000 buses, 12,500 gates

for metros, 80,000 retail stores 72,000 taxis, 3,600 bicycles and innumerable public parking spots.

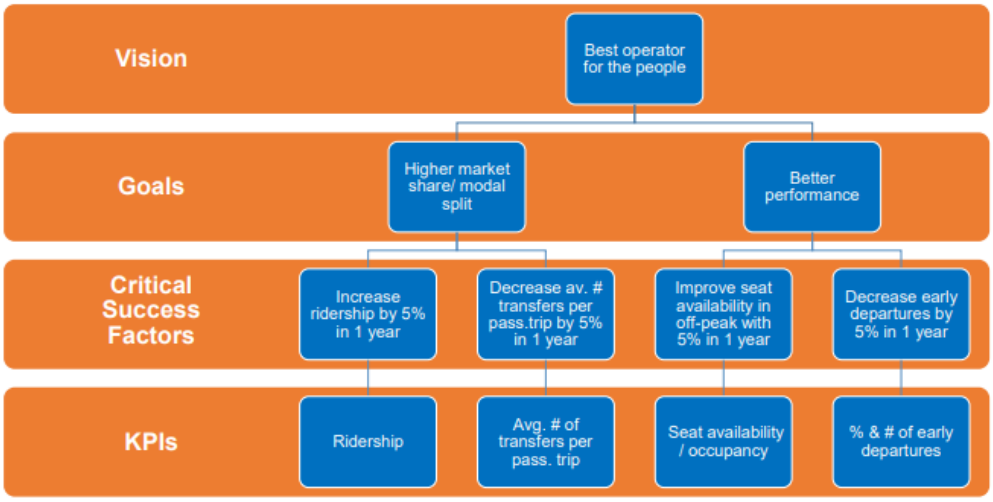
Tmoney cards started with the prepaid cards, and later expanded to post-paid Bank cards, USIM based Tmoney mobile solution, QR based Tmoney pay and cloud-based Tmoney solutions. To achieve a 91.1% card usage rate, Tmoney adapted all other cards issued by other issuers as well. To have national interoperability, Ministry of Transport gathered all existing operators and standardized the use of smart card which was being implemented in phases, so that the citizens did not go through sudden changes. while new cards were introduced, the older cards still functioned.

Tmoney introduced several solutions for smart mobility. First, was issuing tickets for the whole journey in one go, regardless of the mode used. This simplified the payment method and significantly increased the mobile ticketing rate over the years. Second, Tmoney was involved in taxi solution, providing app metre, payment solution, e-hail, and value-added services. Third, Tmoney's ongoing project- C-ITS or Cooperative intelligence transport system, make the drivers aware of the real-time nearby traffic situation, including accidents, potholes, emergency vehicle passing, jaywalking and others. It is based on advance communication technology. It is aimed for assisting safe driving and maximizing driving efficiency. Technology includes constant communication between detector, infrastructure, centre and vehicle. The key feature of this project is that it can optimise the modularized hardware, that is there is a choice between the services required in the mainboard. One can choose AFC, BMS, or CITS, or a combination of these based on the requirements. It also flexibly copes with various communication method and is easy to expand. The fourth smart solution includes Tmoney's goal as a part of big data plan to become an integrated Data Collection hub, which would eventually provide useful data to each stakeholder such as the government, to contribute to their policy-making or decision-making process.

3.2 The advantage of Technology

3.2.1 Data-driven performance improvement in Bus Operations: Zight

An organisation requires a combination of people, process, strategy, organisation and technology for successful projects. There are three key conditions for data-driven performance improvement, which were derived from experience from CDTA Albany. The first emphasised on only selecting the key performance indicators (KPIs), which are aligned with the strategy of the company. This selection is to be based on the KPI tree which is a flow of strategy with vision, goals and the key critical success factors which a company may decide.



The second condition is managing only the KPIs that are owned by the business. This requires knowing the KPI owner, understanding the importance of it, the target of KPI, dependencies involved and knowing the action plan. Only if the all criteria are fulfilled, the KPIs must be selected.

The last condition is that only provide dashboards that are customized. The dashboard must enable the organisation to select KPIs, and analyse all possible problems, causes, measures required to solve the problem and thus decide on the visuals required to find effective measures. These three conditions thus lead to an informed decision based on the journey from data to the results.

3.2.2 Factors that impact AFC projects in India: Aum Infotech

Automatic Fare Collection (AFC) system in India is still emerging, and so it is important to understand Indian conditions while developing and implementing the systems.

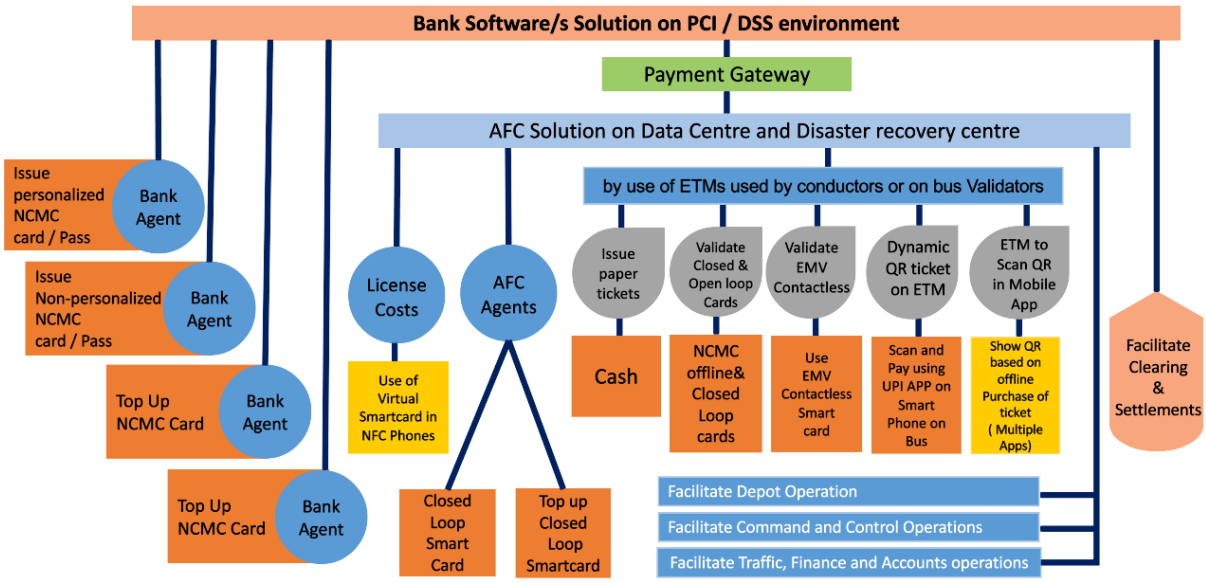
India has been using pre-printed tickets and passes in buses, which are still in use. In the late 90s, offline ETMs, i.e. handheld electronic machines came up, where the conductor used the machine on a particular route, who's route fare matrix was pre-registered into the machine. By the end of the day, when the ETM machine reached the depot, the data was downloaded by inserting a cable to the server and the fare collected by the conductor was deposited by using the cash collection mechanism. The depot server facilitates report relating to the depot, number of vehicles used on a particular day, fare collection and revenue collected for particular trip of the bus or day. This system is still operational and useful to many of the transport operators in India.

Aum Infotech has been pioneering the project of AFC emerged with online ETMs using commercially available AUS devices. At the top of the system, there is a data centre and a disaster recovery centre which takes care of all ticketing machines which are going to be used across the corporation. These servers ensure high availability, scalability, performance and other related issues. The security in these devices need a key management system and is a closed-loop system to take care of fraud-related issues with the Smart cards. The paper tickets are still part of the system, so that, in case

of machine failure, the trip can continue, and the backend system ensures that, the reports can be created based on data mass which was designed including a single crew operation, or a route operation, or a trip operation, all of which are part of the solution, including the monitoring. Each machine can be monitored and KPIs can be generated.

Case: PMPML, Pune: PMPML has 3000 ETMs, 15000 buses, 13 depots, 18 hours of services per day, and 36 types of smart card. in the past 5 years, it has issued around 850 million tickets, out of which 99.7% tickets were issued by machines. This was possible because of engineering solution taking care of battery management, online data transmission, close loop Smart Card validation, and network. Good manpower is required to handle the ETMs, which can ensure that, all machines are updated with the change in routes, schedules and related information to have smooth operations.

Today due to covid-19, there is a thrust towards the cashless transactions. National Common Mobility Card (NCMC), is going to be a part of all the tenders in the future. It will be easy to follow up as most of the toll booths in India have already adopted fast tags, retail stores have adopted QR code technology, and NCMC is just one step ahead. Already virtual cards have come up, through the mobile phones, and more are yet to come. The closed-loop solution would remain, as multiple student passes including concessions are issued, which only make one to ten transactions in a year.



The ticketing machine used by the conductor of the bus, would face several challenges as it would need to make modifications so that it still issues tickets in cash, validates the closed and open loop cards, and also gets into EMV, generate dynamic QR tickets, and be able to scan QR in mobile app. This need to be done by the ETMs as there are several MIS reports which needs to be generated by a public transport operator.

Financial models in vogue: There are several financial models like CAPEX and OPEX and there is a mix of CAPEX and opex model, There also areas in which people are thinking of solutions cost considering revenue from float from the prepaid amount

from the passenger, other is CDAC solutions about which the scope of work is not clear, and the last is the non-fare revenue generated from non-fare options like advertisements. these models difficult for solution providers to understand where they stand into the solutions.

The operators would have to look into several CAPEX components such as on bus components including electronic ticketing machine, in bus charges, validators and driver console. The operator would also be asked to provide infrastructure at depots, POS locations, control centre, data centre for AFC, and data centre for banks.

3.2.3 Transitioning to MaaS

Mobility as a Service or MaaS can be defined as moving away from traditional transport to shared mobility, which is collective but also can complement public transport in a flexible manner. MaaS is the integration of different transport services and access to it in one single digital mobility offer with active mobility and an efficient public transport system as its basis. This tailor-made service suggests the most suitable solutions based on the user's travel needs. MaaS is available anytime and offers integrated planning, booking and payment, as well as, en-route information to provide easy mobility and enable a life without owning a car.

MaaS gives several advantages like complete and easy mobility to users, helps to shape travel behaviour towards more sustainable modes for the city and to the public transport itself. MaaS acts as a tool to provide passengers with better value for money and attract new passengers among the car-owners. The focus is on providing the user-centric experience, having a simple, high quality, impartial, and flexible system which provides personalised reliable information in a transparent manner. It is also about building a strong partnership, between different stakeholders and service providers authorities and the whole ecosystem. Hence each partner needs to find value in the project. Reciprocity in the database should be present which means that sharing of data would provide value to each stakeholder.

It is important to keep a relationship with the customers for providers and operators. A direct relationship with customers helps in visibility of the providers. The data forms an important part of this relationship as it helps the service providers to improve services and business model, and for the cities, it forms a basis for planning and policy creation

MaaS must address several risks. Risk of losing the customer relationship, risk that MaaS 'provider' will become the gatekeeper or someone who controls all the access. Other risks include risk of disclosing data and business model to competitors and the risk of bias in algorithms or unfair competition.

The ecosystem of MaaS is dependent on the end-users, the integrator, who integrate the system at a technical level, service providers, the operators for different mode and the infrastructure. UITP identifies different models of MaaS, based on the local context, different interests and requirements.

First is the commercial integrator, where a commercial actor starts making agreement from different service providers in an open market scenario. Having the advantage of a strong technological provider, it has the risk of converting to a gatekeeper.

The second model is an open back end MaaS model, managed and owned by a local authority providing an open platform for the integration of different transport services and then open the competition for the provision of the application for a phased interaction with the users.

The third model is the transport as the integrator. Here, public transport authority having the advantage of its history and the experience in managing, handling and relating with the customer can start integrating all modes.

Fourth model is the introduction of distributed mobility using Blockchain technology, with all stakeholders working on platform via decentralised ledger technology. This can be a model for the future when the maturity of the technology is known. It may provide a good way for the stakeholders to work in a decentralised way, not having the gatekeeper effect.

In conclusion, it can be said that MaaS can enable future business model in transportation and beyond. It can also be a brilliant tool for more sustainable mobility and can be used by authorities to promote and strengthen mass transportation modes and follow the models discussed before.

Some recommendations identified based on experiences of cities in Europe are:

Start to understand the ecosystem and the needs of the stakeholders. Ensure that public transport and active mobility options are at the centre of any MaaS solution. Data is important and hence the care about data reciprocity, data protection, and data optimization. It is also important to adopt and harmonise quality standards for all mobility providers. Fostering innovation by funding is also promoted. Overcome institutional fragmentation with mobility agencies or multimodal transport authorities as MaaS is easier to implement if a single agency or authority can oversee the activities of the different service providers. Encourage multimodal urban planning for the development of mobility hubs and multimodal infrastructure where interchanges are possible. Include MaaS as a catalyst to reach policy goals (SDG). And also, to create the right framework to promote Maas, as opposed to the colonial framework that supports the private use of cars, parking and the incentives that support car use and thus hinder sustainable mobility behaviour and MaaS.

4 Deployment strategies for electric bus system

Cities around the world are pursuing electric bus planning and deployment strategies to shift to cleaner fuels and to reduce the emissions, improving the efficiency of the transport systems. Government of India (GoI) has adopted initiatives like Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) to strengthen these goals. The cities still face the challenges in planning and identifying context-specific deployment strategies for electric buses, technology and correct procurement models.

In this section, the insights on the e-bus market are discussed in detail, while understanding the barriers and enablers for the same, the technological advancement required and the need for up-gradation of staff capabilities by the means of training. It also involves case studies from international cities, to give insights on challenges faced and experiences gained.

4.1 Insights on E-bus market in India

4.1.1 Learnings from FAME I and II

The impetus of electric bus in India started when the challenge of air pollution in the cities was seen. To address it, the focus was put on reducing the emissions from the vehicular sector. Bus are disproportionately emission-intensive because they have large engine centre and they are within govt authority, and hence, was an easier target to improve. The electric bus programme was launched under the FAME scheme in 2014, which has gone through various changes and phases over the years. The first phase was in 2017, within which 390 buses were sanctioned. The second phase started in 2019, with FAME-II, where Government of India allocated 35% of the fund only for buses showing a clear focus to make public transport clean in India. Till now, 2,450 electric buses are already sanctioned in India under the scheme, but due to current covid-19 pandemic, it has gotten delayed. At the same time, GoI is also focussing on emission improvement through Bharat stage IV and VI emission standards. This is also making the conventional vehicle more expensive for users. So, on one hand, India is supporting buses through electric buses, and on the other hand, it is disincentivising the ICE buses and together it is giving good impetus to the electric buses.

The FAME scheme has evolved over time. In FAME 1 the Subsidy amount was equal to 60% of the vehicle cost which was reduced to 40% in FAME II. At the same time, there was an upper cap to the actual incentive available. In FAME I, it was up to 1crore rupees, as long as 35% of vehicle was made in India. in FAME II, the same was increased to 45% in all vehicle categories, whereas the subsidy was graded so that larger buses would get bigger subsidy. Under FAME I each bus received the same subsidy making cities opt for 9-metre buses instead of 12-metre buses to reduce cost.

So far India has developed 600 electric buses, in a short span of 4 to 5 years, and most of them are through FAME schemes with some city-level initiatives like in Pune and

Ahmedabad, and a few niche applications like Airport tarmac operations. In FAME II, good progress was made with about 2,500 buses tendered. Out of these almost 50% were from 3 big blocks of tenders from Uttar Pradesh, city of Mumbai and the city of Ahmedabad constituting almost 50% of the buses. The states in the south have not made much progress until mid-2020, partly because of the need to move to the leasing model of Gross Cost Contract (GCC). They have traditionally adopted an outright purchase approach. So far, the 2,500 tendered buses are delayed due to the covid-19 pandemic. Based on the experiences, there have been some learning observed.

From FAME I: The cost of buses varied. A 9-m buses cost higher than 12-m buses on a per km basis, and withing the 9-m buses, the cost varied from place to place. Whereas the outright purchase bid almost had a consistent rate. The key reason to this was the contractual conditions, where assured km of payment of operator or service provider, tenure of contract and other factors varied, as each city had their own procurement model.

From FAME II: DHI[2] standardised the procurement process by using the Model Concession Agreement (MCA) by NITI Aayog. The concession agreement is a contract to be given to the service provider, and the tender conditions are up to each entity contracting. Yet, there is a variability seen in the tender conditions between cities, though not as high as in FAME I. Highest quote for 9m and 12m buses 53% and 78% higher than the lowest quotes respectively There is variation due to conditions of use in different cases. In some cases, the least cost(L1) was for intercity operation, which has much higher km per day and hence good payback for service provider whereas the highest was for Mumbai City where the vehicle utilisation is 140-150km per day and hence the per km cost increased. There are some operational constraints leading to this and there is still scope for improvement on tendering and procurement. In FAME II, there are 6 different service providers selected for operating different types of buses. Cities prefer 9m buses because it with smaller buses, the CAPEX is lower. This may lead to cities missing out the peak hour capacity, leading to lesser.

Beyond the FAME scheme. there are two key things which need to be focussed on. One is the high cost of ownership of electric buses. Capital cost and financing of buses, charging infra. and battery replacement constitutes about 37% of the total cost; bidders building in the cost of penalties for non-adherence to SLAs leads an additional cost of up to 7%; other hidden costs include bidders building in the risk premium of likely delay and/or non-payment by authorities and the OPEX cost on staff and energy contributes about 31%. The key area to target is 7% cost of penalty. The service provider builds in the cost of penalties in the tender cost which is the risk on the service provider. Reducing this cost is important. While CAPEX and OPEX remain similar across cities, the risk premium on payments and penalties combined with the return on investment in the form of assured-km of payment determines the level of

[2] DHI: Department of Heavy Industries

cost variability between bids. These are issues which are recognised and DHI is working actively to address them.

The second key point to focus on is the replacement ratio. Replacement ration is the ratio of e-buses to ICE buses to deliver the same service. There is focus on financial aspects, the contract tenure, assured km, type of bus etc in case of electric buses, however the operational planning and scheduling activities that impact the costs significantly are not focussed on. The e-buses have a range and charging time limitations which requiring more buses to serve the same number of trips. In BMTC operations, after analysis of 29 routes, it was observed that the replacement ration could range from 1 to 2.1. So even though the TCO may look same between 2 buses, the actual cost of service is twice with the electric buses. Operations planning and route are also important. In tenders, there are several specifications regarding km operated, the time allotted for battery, battery capacity, and warranty on charging, In GCC operations, most cities assume that the battery is taken care of by the service provider. But if there are assured km, and there is no warranty of battery, then even in the case of low-performance, the operator is obligated to be paid money, which may, in turn, becomes the incentive to not replace the battery. Bus agencies need to focus on planning and scheduling for e-buses before tendering to minimise replacement ratios. Prior planning also enables bidders to arrive at accurate cost estimates and reduces the risk premium.

Key venues for action to accelerate e-buses in India

The top priority is reducing the total cost of ownership (TCO) of procurement of e-buses. There is a need to explore aggregate purchase and vehicle lease models. The cost and variability in GCC procurement can be reduced by improving financial specifications like bank guarantee requirements, termination clauses etc, by assuring contract payment through Viability Gap Funding (VGF) to support to bus agencies, and by reducing the cost of financing for operators

Secondly, minimise the replacement ratio (RR) through operations planning by identifying the depots and routes of operation that minimise TCO and maximise revenues, defining functional and technical specs of tenders to suit operational needs and re-scheduling e-bus routes by incorporating range and charging time constraints

Another key area neglected is the performance evaluation of the buses already deployed. Analyse performance of e-bus, battery and charging technologies in operation to identify their suitability for different operational requirements and to understand challenges in operations and the best-suited technology for India.

And last, build technical capacity for both contracting authorities and operators to manage e-buses. Cities and states need capacity building on planning, procurement and operations management as they are shifting to new technology buses as well from inhouse to outsourced operations. Operators also need skill development programs like training of drivers and mechanics

4.1.2 Barriers and Enablers for E-Bus Deployment, Case Of BMTC

Bengaluru Metropolitan Transport Corporation (BMTC) is the largest urban bus fleet operator in India with fleet 6563 buses and a daily ridership of 3.5 million passengers pre covid-19. The network covers 90% of residential areas and 82% of jobs within 250m of access distance with 2263 routes.

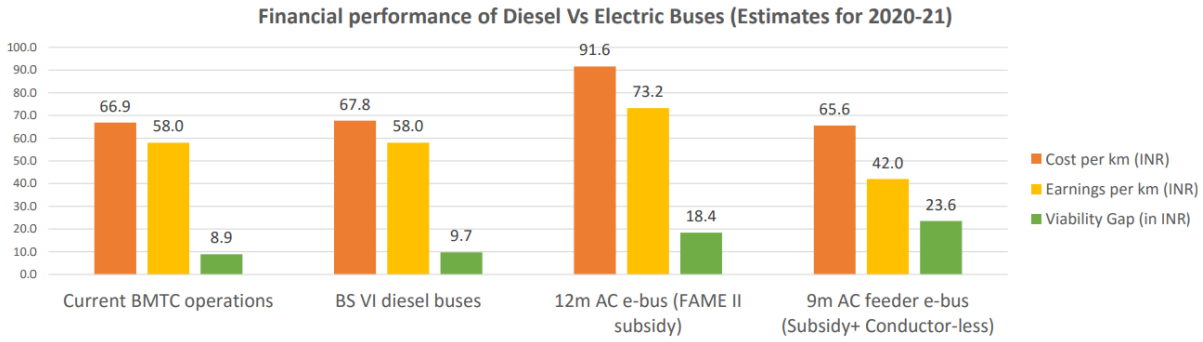
Key innovations undertaken by BMTC involve the first of its kind Bus Priority Lanes with 20 km corridor implemented along 'Outer Ring Road' which would be scaled up by 11 other 'High-density Corridors'. BMTC also has 700 Volvo Air-Conditioned buses, which provide good quality services to bus users. It has 10 Traffic and Transportation Management Centres (TTMCs) through Public-Private Partnership (PPP) which provide information, safe, and comfortable facilities at key bus terminals and help in commercial development with good bus network connectivity. BMTC has implemented Intelligent Transport Systems which have real-time Passenger Information Systems (PIS) through vehicle tracking units and GPS enabled Electronic Ticketing Machines (ETM). It has also worked on the improvement of crew skills and satisfaction with automated leave management system & driving test centres

BMTC Efforts for Electric Buses

In 2014, BMTC did a successful electric bus pilot for three months. Later in the subsequent year plans and sanctions for electric buses were made. These faced difficulties as BMTC has strong in-house management system with low-cost maintenance of buses, leading to the hesitation of moving to GCC. BMTC's huge staff strength involved in in-house operation of buses also made it difficult to move in the direction of GCC. BMTC yet tried transitioning to e-buses in 2019 and 2020, though because of getting bids of high prices and single bidding, they were cancelled.

Based on the experience of pilot and efforts to shift to electric mobility, the **key barriers in implementation of the e-bus deployment** were identified. They are

a) High cost of e-buses,
   BMTC operates diesel buses in-house, given its cost & service efficiency. But under the FAME II model, the procurement required adopting GCC model which involved additional costs like financing costs of operators and building-in of penalties by operators. Along with it, the reduction in DHI subsidy from FAME I to FAME II also increased the costs. Due to the increased costs, BMTC's viability gap per km would turn to INR 18.4 to INR 23.6 for e-buses, which is more than twice the viability gap for BS-VI diesel buses.



b) Procurement and Vehicle technology issues
There are issues with tendering and contracting through GCC for e-buses as it involves twin transitions of technology and business model. The Model Concession Agreement (MCA) by NITI-Aayog helps to understand the key aspects of e-bus procurement. However, some clauses of the MCA prove restrictive, especially the payment timelines (15 days), security deposit needs, termination clauses, and force majeure clauses don't meet BMTC needs.
Identifying vehicle specifications to meet BMTC operating conditions was another challenge. AC Vs Non-AC, short-range vs long-range batteries, etc. need to be defined to deploy on routes with least Total Cost of Ownership (TCO). Lack of vehicle models to meet BMTC's specs is also a constraint.
STUs need flexibility in contracting and technical support on e-bus technologies
OEMs need to develop more long-range bus models to meet operating needs

c) Covid-19 induced challenges: operational and financial implications:
BMTC only operated 150 buses for essential services during the lockdown. Non-AC services resumed with 1,738 buses from 19th May and gradually scaled up 4,322 buses by June. AC services resumed on 03rd June, yet the patronage remained low. Also, the services were scaled down subsequently due to low demand. In August 2020, BMTC operated 2,592 buses at a load factor (LF) of 40% and earnings per km (EPKM) of INR 25 compared to pre-covid-19 numbers of 68% LF and INR 51.8 EPKM. As a result, BMTC faced a revenue drop of about INR 3 Cr for every day of operation while fixed costs remained the same. Investing in high-cost technologies like e-buses during the pandemic time would prove difficult for the STUs.

d) Supply chain disruption was seen as service providers from China (and other border countries of India) were mandated to be registered with Department of Promotion of Industry and Internal Trade (DPIIT), Government of India, to secure projects. Since all e-bus manufacturers in India is heavily dependent on the supply chain from China for batteries, motors, transmission etc, the status of their registration and timeline for approvals remained unknown which may drastically slow down the pace of e-bus deployment due to this

Based on the experience gained, there are some r**ecommended enablers to accelerate e-bus deployment**. During the next year, the regulatory roadblocks for e-

bus component supply from China can be relaxed. The restructuring of the FAME II scheme may lead to an increase in the subsidy per bus and reduce the number of buses per STU. This will allow the GCC costs to come below the Diesel/ CNG costs thereby allowing more flexibility. Providing capacity-building support to STUs to operate and manage electric buses could also help improve the management systems.

For medium-term measures (next one to three years), it is recommended to insulate the STUs from financial risks of electric buses so that they focus on technology and operational risks. STU's find themselves in the dark when it comes to new technology. Centre and States to come together and provide Viability Gap Funding (VGF) on operational cost increase compared to diesel/ CNG buses and encourage higher share of e-bus manufacturing in India. There is a need to develop innovative e-bus models to meet STUs, along with attracting low-interest loans for e-buses from International Financing Institutions (IFIs) and banks. Also, there is a need to explore new models like bulk procurement by STUs for the in-house operation of e-buses which has been a long-standing demand from the Southern States. Technology risk can be outsourced through AMC contracts

For the long-term measures (Three to five years), focus on establishing local manufacturing in India and making rates competitive compared to diesel/ CNG buses is necessary along with identifying best technologies to suit Indian operating conditions

4.1.3 Training Needs Assessment (TNA) for electric buses in India

Laghu Parashar from GIZ, India shared the details of the training needs assessment required for e-bus for the STUs in India on topics ranging from e-buses fundamentals, planning, strategy, monitoring, to end of life scrapping and recycling.

The project is a smart SUT project, i.e. sustainable urban transportation project of giz India. It is funded by German ministry Federal Ministry for Economic Cooperation and Development, GMZ, with NOVA as national partners. The project is supporting and advising three states, Tamil Nadu, Odisha and Kerala in various sustainable urban transport projects.

Bus transportation has seen various technological transition with several degrees of success and failure depending on the capacity of the organisation adopting it. The failure in transition and adapting may point to re-evaluating self-capacity. Hence, to do the same, a systematic assessment of the training needs is required. The transition to electric buses requires a training needs assessment for sustainable adaptation of technology, which ultimately adds to the government support for adoption.

The objectives of the project include undertaking Training needs assessment (TNA) of various roles at STUs across vertically and horizontally across the e-bus life cycle management. Secondly, to plan and prepare training programs. Third, is to prepare organization structure and resource requirement (i.e. job descriptions and standard operating procedures) for operating and managing the e-Buses by PTAs.

Design of TNA framework was done for the project with the help of a transport expert. The relevant stakeholders responsible in the sector were identified including STUs, operators, energy sector, charging infrastructure provider, OEMs and others. Interactions were conducted to understand overall e-Bus deployment and for data collection. The data analysis and assessment were done to identify e-Bus skill gap capacities across the top, middle management and junior level staffs, based on which recommendation on topic and training needs for STU staffs across e-Bus life cycle was decided. It also included preparing a training program and proposing training modules for various roles at STUs, and preparing organizational structure and resource requirements (JDs and SOPs) for operating and managing the E-Buses by STUs.

The operational lifecycle of an e-bus can be divided into 7 functions, including strategy roadmap and planning, technical specification design, procurement, operations, repair and maintenance, monitoring and control and scrapping and recycling. Each function was divided in sub-function which would also have further subcategory. The data collection was divided in supply-side and demand side. The demand side included all public transport authorities and supply-side include the industry vendors. The survey for the project was done in Shimla-Manali, HRTC, Navi Mumbai, NMMT, Bengaluru, BMTC and Kolkata, WBTC.

The initial outcome stated that STUs have *'Low'* skill levels for repair and maintenance and scrapping and recycling functions. Delays in undertaking maintenance activities can cause delays in breakdown repairs, and higher downtime of e-Buse. It can also mean, STUs lack the clarity on remaining battery life expectancy and its reuse/ recycling procedure.

The strategy roadmap and planning function, have *'fair'* skill levels leading to insufficient preparations to provide infrastructure to the operator resulting in a delay in deployment leading to overall sub-optimal performance.

For the technical specification design, operations and monitoring and control functions, STUs have *'medium'* skill levels. The sub-optimal choice of battery size may result in operational challenges of not meeting range which reduces e-Bus productivity and leads to revenue shortfalls. Poor utilization of assets also affects the fleet productivity, trip loss, route misses affect customer services, schedule disruptions of chargers and e-buses charging.

For the procurement function, STUs have *'high'* skill levels. However, the challenges faced include delayed/ multiple times cancellation of tenders, less discovery of optimal price level, and weaknesses in contract enforcement.

Strategy Roadmap and planning:

Based on these challenges, about 28 categories of areas with training needs were identified under each function. All training programs were further divided based on the type of training, the hierarchy of training and also based on the business model

used. Based on skill gaps across e-Bus life cycle stages, total of 8 training modules were identified, which are further sub-divided into total 32 sub-modules.

The 8 training modules for e-bus were:

fundamentals and safety
technology planning specification design and selection,
financial planning and strategy
bus procurement
operations planning and implementation
monitoring and control
repair and maintenance
end-of-life, scrapping and recycling

Proposed structure: It is envisaged that there would be trainers and training content partners with a national partner who'd certify the program and content. This would be under the partner ministry. Once the module is completed, the dissemination would take place to the training centre and institutes with different potential brands, faculties and infrastructure.

4.1.4 Electric Buses of Present and Future: Siemens, India

E-mobility is a concept of using powertrain technologies, in-vehicle information, communication technologies and connected infrastructure to enable electric propulsion of vehicles and fleets. i.e. it is the electrification of any vehicle using any technology.
Buses are usually classified into two types of e-vehicle, either based on length or based on the technology used, be it. Based on size, there are standard buses which are most common, then are airport buses, double-decker buses, articulated buses and double articulated buses. These buses can be powered in multiple ways. They can be charged at depots, or by using top-down pantograph while moving, with special charging cells, or have in-motion charging.

Vehicle mechanics are being electrified, whether based on battery or fuel cell, forming a unique electromechanical experience which led to transition from ICE engine vehicle, to electric buses. The hybrid buses can be of two types, the parallel hybrid or the serial hybrid. The Parallel Hybrid uses transmission and electric boost, with combustion engine with electric motor acting on the drive shaft via a common gearbox. Here, the electric motor acts as a generator during braking. The performance of the electric motor is significantly smaller than the performance of the combustion engine, so the combustion engine must run for full power. Here, conversion to battery ("zero-emission") vehicle would require a complete system change.

Whereas, the serial hybrid has only one electric motor which has full capacity to draw the vehicle which simultaneously draws power either from the ICE engine or from the

battery storage. It switches between ICE to battery based on the requirement of the engine. It uses electric traction, with only the electric motor attached to the drive shaft. Once a vehicle is built-in with hybrid model, which are the battery and ICE engine based, then the conversion to the pure battery is easier because one just needs to replace the ICE engine with larger battery storage so that the entire range can be supported by the electric bus. The transition of a serial hybrid bus to a purely electric bus is much easier.

Depot Electrification

The STUs or the operators are used to working with the traditional fuel-based vehicles at the depots. They are used to dealing with stakeholders like fuel supplier, diesel bus OEM, diesel refuelling provider, vehicle and driver scheduling and traditional IT providers. But with the electric vehicle, these stakeholders change and the system becomes more complex. Instead of fuel supply, operator has to deal with utility, as there is a requirement of constant reliable power for the system to run. Another is the e-bus OEMs who are new on the learning curve with facing challenges like optimisation of the battery pack, motor-size, etc. where the operator and the city have to bear the brunt of the experiment. The next is charging infrastructure, for building, connecting and matching the energy dose. The energy consumption of e-buses is significantly higher than the diesel buses. This poses a difficulty of finding big power supply at a crowded depot in big cities. This depot electrification results in more complexities for the operator and needs to be realised early in the project.

To cater to high load requirement, a reliable combination of new technology like renewable energy from the rooftop of bus depots, or adding battery energy storage with batteries used from the second life of the electrical vehicles which are used in the implementation and that combination can already be planned envisaged, for the bus depot to be self-sustained. However, it requires strategy planning based on real-time requirement of the depot and based on consumption of buses. The routes or infrastructure laid over the electrical infrastructure of the city, shows the spots where electrification cannot be easily implemented. Such comprehensive planning must take place when planning for the electrification of entire routes and depots.

Electrification system

When comparing the overnight charging strategy and the opportunity charging, its seen that the weight of the battery increases with the overnight charging, decreasing the passenger capacity of the buses, whereas with opportunity charging since the battery is small, the weight is less. Also, the depot power requirement is less with opportunity charging. It is very suitable for complex metro cities where there are traffic conditions, which allow the bus to be charged at the bus stops.

The customised financing, full simulation, grid connection optimisation and depot layout possibilities has to be taken care of in the planning phase. The operators take account of a number of buses and route planning in case of electrification, but often miss out the operation of the charging infrastructure, or the mid infrastructure required for these buses to be maintained to their promised timelines. The Siemens optimisation

is a mix of AC charging, DC charging, pantograph charging, where depending upon the route sharing and management, it can be prioritised. The same system can be used for a different type of e mobility services. When planning for charging infrastructure at a place, it needs to be future-ready and does not need to be linked with a particular bus or OEM which is important for interoperability. Larger bus depots are now becoming the big node centres and the distribution companies would also hope that these large depots or node centres help them to manage their distribution grid.

4.2 Case Study:

The following international case studies give an idea of the implementation strategy for electric buses and real-time challenges.

4.2.1 Implementation and promotion of the e-bus fleet and its policy in Chile

The Metropolitan area of Santiago covers an area of 680-kilometre square with 7 million inhabitants. It has six bus operators with Metro and urban rails, and approximately 2.5 million public transport users. It conducts 4.6 million daily public transport trips of which 40.7% are motorized trips. The bus system has 6700 buses with 380 bus routes and more than 26000 workers. It is integrated with metros and suburban rails and has GPS in buses for fleet management with smart card share collection facility available.

In 2017, there was bidding for 6 business units in care of 15 electric buses, which failed due to free competition issues. Later, tests with 3 electric buses between 2017 and 2018 were successfully conducted in the city. Between 2018 and 2020 almost all business units had completed the lifetime of their buses, resulting in a mandatory renovation. Hence, in 2018, 690 new buses (490 EURO VI + 200 Electric) were commissioned. In November 2018, the first 100 e-bus were procured with an alliance between government + operators + utilities. In parallel, a tender of 2,000 buses was also on the way, separate from the operator's tender.

The contract model was used from 2011-2018 for large business units with no separation of ownership of assets and operation. They were long contracts and had heavy penalties in quality of service, with difficulty for replacing non-performing operators. This led to the requirement of a new model which separated the active investments from their operation contracts.

In the 2018 business mode, the operator was the buyer of the bus, but it was a lease in a contract and not an outright purchase contract. The factory constituted of special purpose vehicle (SPV) leasing out buses with a supply contract and the operator earned from the buses. However, the payment was received directly from the financial authority by the sent and cession of flows which guaranteed the payment of the quota of the buses. With this system, the deployment of the buses started. Enel X, Metbus and BYD introduced the first 100 electric buses in the electric corridor of Grecia Avenue in December 2018. In April 2019, the fleet increased to 200 Electric buses with the entrance of 100 Yutong Buses in the E-Corridor of Alameda and

V. Mackenna Ave. By August 2020, Santiago added 425 more electric buses from Kinglong with Vivipra, Transdev, financed by NeoT, (25 buses), BYD Buses with new finances from ENEL Refinance (150 buses), and FOTON Buses in Alliance with STP-KaufmannSociété Generale and BNP Paribas (250 buses).

In the current tender, the new 2020 Contract Model is being used. It is similar to Bogota Model, with a difference of absolute separation between the operators. These have Smaller Business Units, and separation of ownership of assets and operation, which allows shorter contracts for incentive in service quality and replacement of bad operators. The contract is extendable to 5 or 7 years, based on the KPIs[3]. The garage is provided by the ministry. The objective is improving the quality of service, as the penalties alone are not effective to achieve the same. So, in this model, instead of a penalty, the operator stands to lose the contract if the performance isn't up to par.

There were several innovations made for services like new app for passengers were created, network of public transport was made, new lines of suburban trains and metros were laid out, pilot of autonomous vehicles was done, Wi-Fi development of 5G was done, Demand Responsive Transport (DRT) pilot was carried out, and new models of buses were carried out.

Transantiago earlier achieved the negative image of a brand with stoic failure and bad public policy. So, an opportunity was realised and a new brand was created viz. RED. In Spanish, red means network and the buses were coloured red to give an overall rebranding. The new brand identified the new standard of the public transport system, which changed the paradigm about the established and perception of people. The new Red Metropolitiana de Movilidad was different from the earlier Transantiago. The system transformed from buses to sustainable multimodal system, massive transport to mobility-quality-and-dignity, overpromise to pragmatic solutions, and finally from aiming to be world-class system to a system focussed on the happiness of the users.

In the first month of the service rollouts, the perceptions of the users changed and the rating from the customers for the system increased dramatically. The perception of people about public transport services was also captured. Earlier, with Transantiago, 46% passengers had a good perception of the buses whereas with the red system with increased to 57%, where red comprised of both Transantiago and red system.

Recommendations

In order to start with electric buses, it is important to convince oneself about the project. Seeking collaborations and doing assessment to know what is required for the local conditions considering all aspects of service length + charge type + charge model + bus weight + passenger capacity + consumption cycle + slope of the ground + available time for charge + energy price + project finance + garage location + available power + investments + fare + subsidy is important.

[3] Key performance Indicators

Pilot an electric bus in the city can also solve the technological issues. Fine-tune business model and open the vendor matrix without capture; explore green funds. Negotiate the conditions of provision (scaling, spare parts, post-sales, batteries). Solve the operational + software equation and put a fleet up and running. Prepare for the human capital including drivers, operation, firefighters. Enable marketing: choose a high-visibility route, add attributes, tactical urbanism, user ownership, create a standard, measure Q&Q, relieve environmental and gender improvements

Learning and Challenges

It is required to make the decision and generate technical and political consensus. Algorithms, cables and spectrum are the new infrastructure and need to be considered in planning. There may be a need to form new human capital resources for the management of the new technology. Reconciling public policy objectives and profitability interests (economic and social) would help in the long term. It is important to balance the theoretical and practical knowledge to one's benefit, negotiate fleets + software + spare parts in the tender, and plan electricity or future energy needs and sources. Focus must also be given on recover of empty kilometres and territories.

4.2.2 Key elements for decision making in e-bus operation, CUTCSA

CUTCSA (Uruguayan Company of Collective Public Transport), is the main public transport operator in Montevideo, Uruguay. It has been in the business for 83 years, operating 1200 more buses where each bus is considered a single unit itself. In Montevideo, more than 95% of the energy generated is from renewable sources. As a result, the country has a flat energy surplus from 12 AM to 7 AM. It is a huge opportunity for electric mobility, mainly for buses which charge overnight.

The government sees the public transport as a great energy consumer. A series of benefits were established by them to encourage the addition of electric buses in public transport. A technical committee was created where all stakeholders participated. In this process, all requirements to apply for the subsidy were defined. The acquired experience in 2016 project was input for the turn and event solutions for the reality of the country. One solution was identifying the incorporation of electric buses as an opportunity to raise the standards of public transportation in Uruguay.

CUTCSA owns the entire ecosystem of public transportation, from planning operations, charging-centre to charging management. To innovate, the innovation itself must be adapted to a business model and not the other way round. The share package of the company was mostly made of little owners that worked as service operators.

Key planning consideration for 2016 project

The 2016 project consisted of studying a single electric bus in real conditions and studies what steps are necessary to incorporate the solutions in the city. So, they started with the study of technology and followed up similar projects worldwide. Then a validation protocol of technical characteristics indicated by manufacturer took place followed by resource training for staff, and last performance evaluation under

real service conditions according to the business model. Along with these, CUTCSA also had to develop their own management tool.

Route solution: The 2016 project laid the criteria for service operations, like distance, profile, permissions of government, autonomy profile, obstacles etc. The different stages of the project included the pilot test of an electric bus, then replacement of few auxiliary fleet, adding 20 new electric buses and putting up a charging centre in place.

Charging management: Based on data seen from real service conditions, parameters for an optimal charging plan were decided. These parameters included battery consumption, battery status on the road, air conditioning etc. The data was extracted from the operation of 1,37,400 km of operation with approximately 0.5 million passengers transported. The pilot of 2016, included understanding charging management and management system, through 5 electric car usage for real-time practical monitoring.

Protocols: Based on the prior experience, several protocols for charging solutions, real-time monitoring, fleet management, and service profitability were defined, to ensure correct usage of vehicles.

Real-time monitoring: Having real-time data allowed to make quick decisions in cases of unforeseen events in operations, such as clashes etc. and also allowed to monitor the battery to prevent loss that could damage them in the long run. It is important that all tools for management are based on the city's specific need and management.

Fleet management: Proper management of all actors on board is crucial to allow efficient service management. This includes driver, service owners, charging centres operators, maintenance crew etc. It is logical that it is easier than the same company is that manages all the parts.

From the experience acquired from projects, it was determined that some factors which are crucial for electric bus operations are data monitoring, training, planning and operations, charging protocols and management tools.

5 Governance and financing instruments to sustain bus operations

This section tries to bring out measures using which, the bus-based public transportation can be made sustainable through innovative solutions. Learnings are drawn from the case study, experiences in projects, insights from financing institutions, and also from the analysis of data obtained from service provisions are discussed below.

5.1 Data-driven performance monitoring of buses: DIMTS

The bus-based transport in Delhi has undergone several reforms over the years. These reforms have brought about the experience to the city for innovative services. In 2001, the Delhi city fleet converted to single fuel mode on CNG. During 2007-08 the private bus operation was revamped under Public- Private Partnership Model (PPP) that took place with 50% fleet procured through the organized scheme.

The current plan includes for Delhi includes, the introduction of pure electric buses in Delhi and implementation of PTx2 strategy for doubling the market share of public transport.

Public transport scenario: Delhi

The Delhi Metro operates for about 389 kms with a daily ridership of 3.0 million per day (pre-covid-19). The state-owned Delhi Transport Corporation (DTC), holds a fleet size of 3,762 buses with ridership as 3.3 million per day (pre-covid-19). The Delhi cluster scheme has a fleet size of 2,831 buses with a ridership of 1.8 million per day (pre-covid-19). Other IPT modes include auto-rickshaw, taxi (city), app-based services, e-rickshaw.

Delhi plans to make double the fleet size and increase it to 11,000 buses. DTC plans to procure 300 electric buses and 1000 low floor buses for which the tender has released. In the case of cluster buses, there is a plan to roll out a tender for 1000 electrical vehicle and 600 low floor buses under PPP.

How city bus system was revamped in Delhi: Cluster Scheme came about in Delhi via induction of buses under PPP Model (GCC) which was framed by DIMTS in consonance with the provisions of the MVA, 1988 on behalf of Delhi Govt. (Scheme was duly upheld by Hon'ble High Court of Delhi) in the F.Y. 2007-2008. All the 657 scheduled routes were grouped under 17 distinct clusters based on the two criteria:

1) Routes with 10 km or more of common path put in one cluster
2) Routes on contiguous alignment to provide network benefits.

Each cluster was a combination of high, medium and low demand routes (the idea being that the high demand route can generate enough revenue to compensate for the medium and low demand routes). Identified clusters were then published on DoT website for suggestions/objections. Based on the responses, proposed clusters were revised and notified

Characteristics of cluster scheme are:

- Public Operator (DTC) and Private Operator (Concessionaire) run the operation in the ratio of 50:50. And the public and private operators follow a unified time table to ensure timely and reliable bus service to the public. The contract type is the Gross Cost Contact with no transfer of revenue risk fare box collection to government.

Need of GCC model: The project structure should mirror the technical and operational challenges. Vehicle specifications can be functional or more technical. In GCC contracting option, the focus is on a functional specification which gives the advantage of **more flexibility** for the manufacturers and leaves the technical responsibility completely with the manufacturers.

- Gross Cost Contract includes the development of an eco-system for the operation of buses (both CNG and electric) based on clustering of routes for the formation of the economic unit for open bidding. Their obligations include guaranteed on-time payments, provide for inflation indexation towards the cost of fuel and manpower, provision of depots with supporting infrastructure, public operator to run in accordance with the unified timetable and finally provision of power load (for electric buses)
- It is the responsibility of the government for the management of the cluster model for the GCC model. One key area of it is planning and scheduling of service plan including timetable, real-time passenger information system, real-time monitoring of operations of buses, monitoring of buses from depots as per service plans, driver quality and performance monitoring, inspection of buses for compliance, and most importantly monitoring operational indicators.

Bid parameters – Based on innovative financing

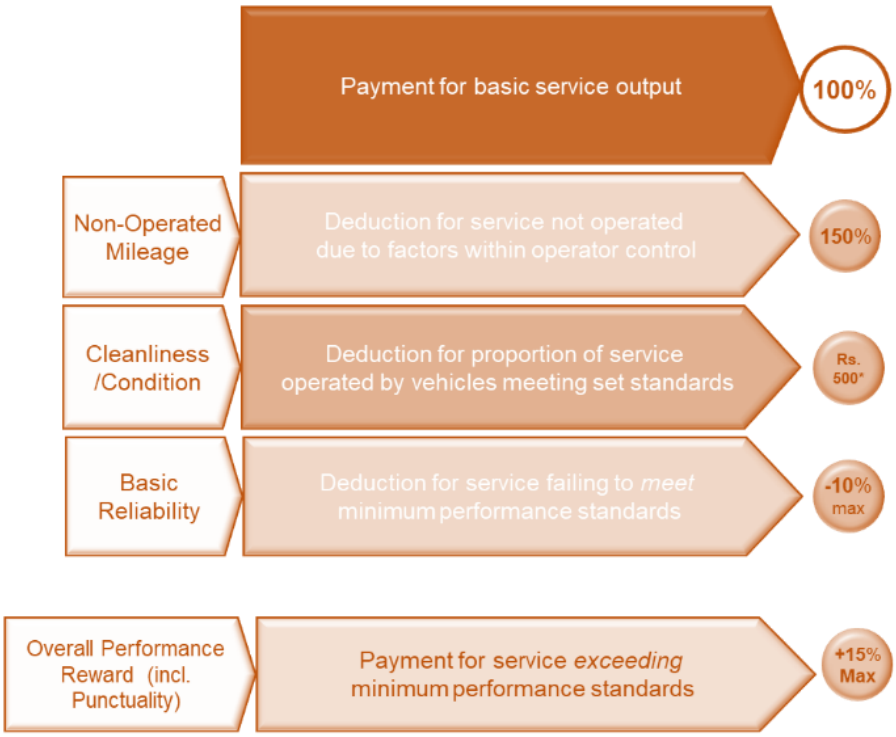
The bid was divided into fixed cost and variable cost. Since the capital investment on the rolling stock would be made by a private entity at the start of the contract, it would be amortized at the concession period of 10 years, so whatever is quoted would remain flat during the 10 years. Another is the manpower and overhead charges which would depend on the actual hours of operation and real-time steering hours. The cost of maintenance and cost of fuel is a function of service kilometres and is called consumable charges. Hence the bidding is based on this classification of operation cost.

The capital charges are fixed charges. The consumable charges are 70% linked to base price of fuel 30% linked with CPI-IW[4]. This distribution of 70:30 was based on internal regression and was found to be the best ratio. The manpower and overhead charges were also 70% linked with applicable wages on the due date of tender, and 30% linked with CPI of industrial workers in Delhi

The stage carriages in India get permit of five years, and the life of buses is approximately 10 to 12 years, so in Delhi's case, after induction, they have kept a concession period of 10 years in sync with the life of the vehicle.

DIMTS believes in performance regime and have provision for incentives and penalties based on the performance of services. The chart below gives details of the penalties to be imposed in case of suboptimal performance of services.

[4] Consumer Price Index Numbers for Industrial Workers



* Per default - Provision of penalty on entire fleet on 10% sample checks.

Fee Payment

The fee payment schedule follows the method of payment of 30% of estimated payment on the 15th of the month of operation, rest 30% of estimated payment at the end of the month, and the remaining payment - the performance adjustments paid on the 10th of next month. This is ensured using an escrow account in case of Delhi. The payment of the month comprises of capital charges for the month, consumable charges, manpower and overhead charges depending upon the actual service kilometres. However, if the use of reserve fleet caters the extra demand, there are some short-term marginal rate provisions, and the payment is made accordingly. Similarly, if there is a need to increase the number of buses in a cluster, they have a provision of long-term marginal rate in their contract.

Performance deductions

There is a cap of 10% performance deduction in the case of private entity, however, damages in case of failure to meet assured fleet availability, the limit of 10% is not applicable. And the same goes for any other road safety parameters like fatal accidents over speeding and signal jumping, to ensure that there is no compromise on road safety.

Use of technology: ITMS components

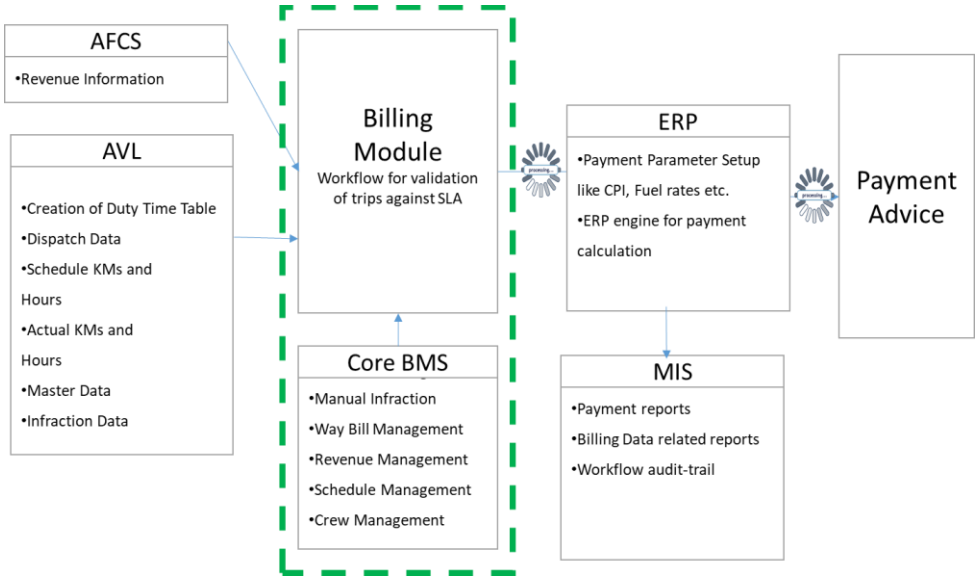
The use of Technology-ITMS components is done extensively. All vehicles are fitted with AVLS, or Automatic Vehicle Location System. Since all buses have bus conductor, they carry handheld devices for ticketing called EVM or Electronic Ticketing Machine for the AFCS or Automated Fare Collection system. The power of both the system is integrated through BMS or Bus management system software which is also web-

based. Delhi also has state-of-the-art Operations Control Centre (OCC) for efficient management of traffic flow, real-time operation of traffic through Intelligent Signalling System, AVLS and more. It does round the clock monitoring and supports the feedback and suggestions from passengers. The AVL system is equipped with automating alert for route deviation, over-speeding, bus bunching, and Idle buses. The buses also have a panic button for women safety. All these are monitored in real-time in OCC.

The new generation ETMs in the buses provide real-time data transfer through GPRS. They are smart card enabled and have over the air configuration to update master data, configuration data and application. The Delhi metro card, which is issued and maintained by DMRC is also extended to the buses. This card can be used as an e-purse to purchase tickets in the cluster buses.

Bus Management System (BMS) has been developed by DIMTS – creating a backbone in a single application for integration with all the sub-systems of GCC operation, such as AVLS, AFCS, waybill submission, infraction recording etc, billing process (Concession Management) is done based on these inputs.

The concession management process is fully automated and all system and performance indicators are generated online.



The data generated through GPS and AVL system is also used to determine the traffic jams, whose benefit is given to the concessionaire in case the service trip could not be operated due to the traffic jam. There is a tool present to determine the presence of jamming traffic, to which, the entire payment of service hours by the operator, is made i.e., the risk of traffic jam is taken by the public transport authority. In case of Delhi, this is built in the service contract

Delhi also does differential scheduling on the basis of travel time history data for optimisation of round time table. Data time generated from last 3 months is observed,

outliers are removed, and an average speed logic is entered, and it is checked that at what level is 85 percentile services levels are observed, based on which calibration of time table for optimisation of services is done for all routes.

Several analysis are undertaken by DIMTS based on the data collected like service plan improvement based on passenger profiling, analysis of ETM data for route optimisation, finding earnings per bus, determining the performance of cluster routes, the impact of differential scheduling on performances, KPIs generation, boarding alighting pattern, kilometre efficiency and missed km monitoring tool and route ranking index among others to continuously bring about improvement of the services.

DIMTS also provides mobile apps for passengers called the one app including real-time information for metro, DTC, and cluster buses. Information is available route wise, with ETA at bus stops, seat availability in buses, trip planner, route details, and feedback options available.

5.2 Public transport service contracts based on learnings from Europe, and approach that can be used for India

The economics of public transport include simple basics. If revenue is higher than costs, then the system is a profit-making system, else it is loss-making. If in public transport, the revenues are less than the costs, then the business isn't sustainable. Possible options in case of loss-making operations are **reducing cost** through efficiency and productivity increase and by postponing investments; **Increasing revenue** through ridership increase and tariff increase, along with service level adjustments with reduction of service level, or even termination of services. Here the government financial support comes in, with a subsidy to cover losses. If the govt recognise public transport as an essential service, then financial support becomes easy to gain. Besides, public transport may reduce congestion and is environmentally friendly

Public transport development in Europe

Public transport in Europe was loss-making in the 70s and 80s with more emphasis on cars, but public transport was regarded as an essential public service and were thought to be continued. Subsidies became available to both public and private-public transport operators to "replenish" losses. To a certain extent "open-end subsidies" were applied, while in some cases private companies were taken over by the government (nationalised). As losses were covered anyway by governments, there was a limited incentive for operators to attract more passengers or to reduce costs. Cost-coverage declined in some cases to 30%. Public transport services were not subject to competitive tenders and the governments had limited insight (or interest) in value for money and the quality of services delivered. So, the transport operators were exposed to tariff policies and sudden reduction of subsidies (political arena) which if did not cover the capital costs, then the operators faced difficulties to finance the renewal of assets (buses).

The National governments wanted to reduce public transport subsidies (through privatisation and/or competitive tendering). EU prohibited state-aid (subsidies) to private companies. After extensive EU-studies, new EU-regulation was designed where subsidies were replaced by compensation payments under Public Service Contracts. In addition, public transport services would become subject to competitive tendering.

That is, EU regulations moved from coverage of losses towards pricing of services.

Principles of a public transport service contract

A public service contract is a legal agreement signed between a transport authority and a transport operator.

- Transport authority (various levels possible) defines the quality and quantity of public transport services. It is purchasing agreed public transport services through a contract, which makes service payments to the operator for services delivered.
- Public transport operator operates bus services in accordance with the contract; receives contractual service payments for services delivered
- Transport authority and transport operator agree on monitoring service delivery under the contract and on the management of the contract and assets.

The service contract is a legal requirement in the European Union, for both public and private operators and is awarded subject to tender procedure. It requires transparent payment formulas for service with a maximum duration of 10 years for bus service.

Learnings

Some of the learnings from Europe are that with fixed contracts, it is possible to have better transport budget control with clear distinction of tasks and responsibilities, transparency and clarity, and having a clear focus on delivery and output with reduced political interference. The shift to purchase of services has increased awareness at Government to get value for money as a clear specification of public transport services to be delivered are known, with a professional business model based on service payments under a contract, identifying and allocating of risks and asset management also becomes clear.

Due to these contracts, there are some cost reductions which take place as a result of competitive tendering of services. The protection of employees also prevents competition on labour costs. This leads to improvement in service quality with clear specification of quantity and quality of services, strict monitoring of performance under the contract. The introduction of incentives and penalties, and competition on quality, not only costs also add to the service improvements while shifting from production-oriented operations towards customer-oriented. This has increased customer satisfaction.

A strong and professional transport authority is required to be in place and have the resources to plan, organise, contract, manage and monitor public transport services. Municipal and state-owned companies often became subject to corporatisation with government at arm's-length. With the contracts, no uncertainty for transport operators

about financial support from the government is present which allows for sound business planning and capital investments with long term funding secured. There is also eased access for operators to finance investments through solid revenue stream under Public Service Contract. To mitigate the impact of operational speed on costs, service payment formulas increasingly based on bus hours instead of bus kms.

Along with the benefits, it can be seen that the competition for contracts became limited. Markets are usually dominated by large international operators (e.g. Transdev, Keolis, Arriva). For larger contracts only 3-4 bidders are present. The outcome of tendering is sometimes disputed (in particular when qualitative tender criteria are dominant).

The development of advanced monitoring systems through dashboards by using ITS and big data enable monitoring operator's performance, customer satisfaction, and travel data. Transport operators are increasingly encouraged to innovate but it also requires flexibility in contracts (multi-modal solutions, MaaS). The lesser the number of contracts are easier it is to manage and allow for the economies of scale. In general handing-over over of operation contract to new operator works reasonable (employees, buses, depots) despite being complicated matter. Some legal provisions safeguard the protection of employees. It is also important to have flexibility in contracts to deal with the changing market circumstances and have innovation.

Overall, the introduction of public service contracts in Europe has brought many benefits in particular in cost management and improvement of services. However, it takes considerable time to build up experience and knowledge for both transport authorities and operators to apply PSC's. Tendering of services and management of contracts may be considered as a substantial administrative burden and is a very complex matter. Applying PSC's to state-owned or municipal transport operators has significantly improved performance and professionalism

For India, there needs to be appropriate and tailor-made legislation around the principles of public service contracts, a sound national financial framework to finance the operations of public transport under public service contracts, and a professional transport authority with sufficient mandate, resources and budget.

It is important to recognise that public transport is an essential public service and appropriate provisions and resources should be in place for it. Agreement on how public transport in India should be organised and the reform agenda should be followed up by strict implementation. A robust model for financing public transport operations should also be present, covering operators operating expenses and investments (shift away from financing buses) and lastly, development of strong Transport Authorities in charge of planning, financing, organising contracting and monitoring of public transport is important.

5.3 Governance and performance monitoring through tech Integration for mobility in India: Uber

There are four important levers of governance, on the input front for mobility planning.

First is **making an informed decision** (planning). Building mobility & cities together need to be looked into. Demand assessment must be done to identify congestion hotspots. Commuters may always have route preference and there is a need to evaluate those routes on the basis travel data. Uber can bring in historical demand data based on traffic movement. Its deployment of vehicles can be used to assess demand on lean routes and to understand the peak demand/ hours to prepare ahead

The second is there is a need for **methodical investment**. Expansion vs new routes must be methodological. Resource allocation must be based on data analytics and project evaluation must be taken based on scenarios. Deployment of shared mobility for lean demand can be taken into consideration, with fleet capacity being decided based on demand. Multimodal integration is required to simplify investments analysis.

The third is the **monitoring of performance**. Public transport system must have visibility on fleet movement, to know if the fleet deployment and scheduling done using demand-responsive approach. The solution can be live tracking of buses, journey time for schedule monitoring, ridership data for each route to identify demand

Fourth include **maintaining accountability**. The safety protocols monitoring digital payments must be present. After covid-19 there is a requirement of contact tracing, social distancing on transit stations maintaining accountability, building mobility & cities together, demand assessment to identify congestion hotspots and route evaluation based on travel data. The Pre-booking & ticketing beforehand could be used to reduce crowding, for geo-fencing and contact tracing, in-app safety checklist and feedback.

On the output front too, levers of governance can be put in 4 categories.

First is **agile asset management** which leads to building a responsive network based on quality information led decision making. Secondly, the system must be **efficient**, **reliable and optimized** which will lead to the augmented capacity to plan and upgrade efficiently, with increased cost optimization through performance monitoring. Thirdly, the **agile asset management** would lead to an informed decision on the number of buses or the capacity allocation based on-demand data, with network optimization and First and last-mile connectivity planning. Lastly, having an **efficient, reliable and optimized System** would ease the up-gradation of systems due to standardized technology and protocols and the performance-based budgeting and visibility on transactions would be increased.

With the covid-19 pandemic, Uber uses technology to have safe solutions for the passengers, including facial scanning of drivers with masks on, having geo-fencing enable using technology which would restrict the movement from the containment zones.

Uber understands the importance of public and is already partners with public transport authorities while providing IT solutions to public transport while the authority owns and operates all other infrastructure. Provides a range of tools & dashboards empowering agency to manage the operations efficiently. The second solution is Uber bus services. While having buses on Uber app, one can book a ticket online like uber cabs. And the third is, Uber network & platform services to support & boost the existing city bus transit by providing first and last-mile connectivity enabling a multimodal transport.

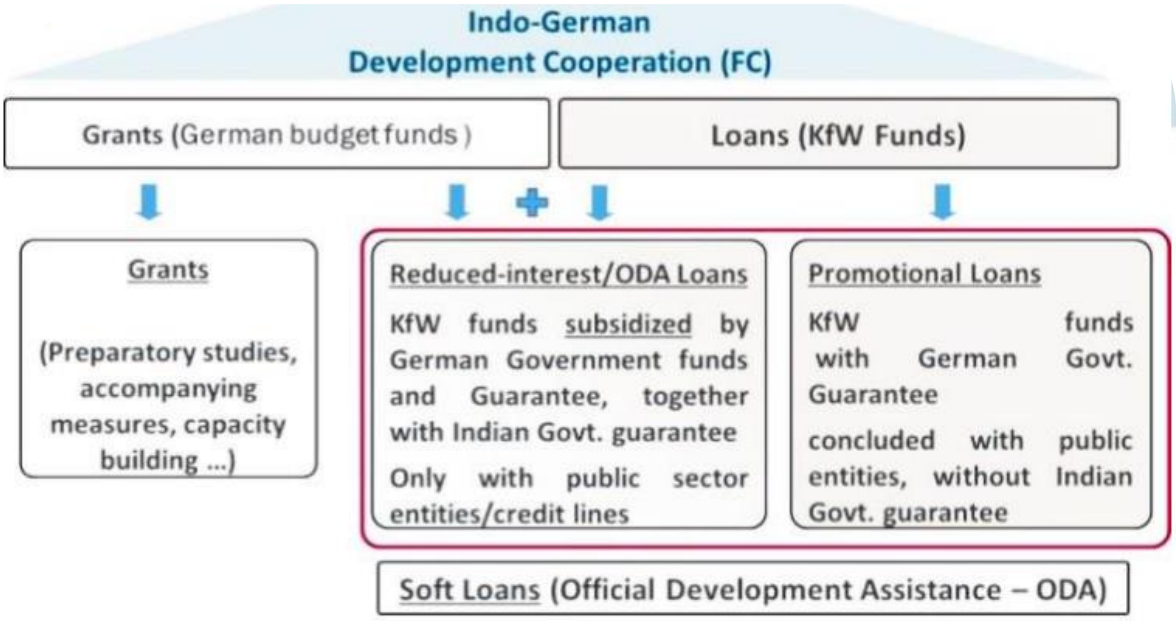
Uber Bus initiative has offered premium bus services internationally on select routes by providing riders with an informed decision for route selection, nearest bus stop selection, journey details and enables them to secure bus pass through the app. It has also complimented bus services by providing feeder services for first and last-mile connectivity at terminals. Secondly, by complimentary bus service for target users/ area via Uber platform. And thirdly, during lean-hour, Uber has provided bus service at late night, during low demand times, for transit deserts.

Uber app could enable the transit integration progression for journey planning from end to end, using in-app ticketing and by enabling riders to use multiple modes to complete a trip.

Increasing ridership and access to transit agencies can be enabled by uber using measures like Uber Kiosk for rider support on transit stations. It can provide services like multiple modes of travel where the rider can choose based on price & comfort with the availability of various payment options - cash, e-wallets, gift cards, debit/ credit cards. It can also provide access for people with reduced mobility through wheelchair assisted vehicles (licensed UberACCESS vehicles). It can improve rider experience through last-mile riders for subsidies via Uber platform, and provide a dashboard to book Uber rides for riders and monitor active trips in real-time and by the pin-dispatch system to avoid queuing.

5.4 Readiness of government bus operators to attract low-cost financing: KfW

KFW development bank is the financial arm in the Indo-German development corporation, with giz being technical arm. The key areas of this Corporation are urban mobility and sustainable urban development, energy (access to energy, renewable energy, energy efficiency) and natural resource management (forestry, ecological agriculture). Under Indo German Development Corporation, the investments can be divided as shown in the figure.



KFW is interested in bus sector as it is flexible and far-reaching, fast and scalable, low-cost solution which is affordable and inclusive with advanced technologies and potential for the green sector.

Key challenges in bus sector in India

The key challenges are increased shift towards private transport leading to negative environmental impact, limited coverage demand-supply gap, lagging service delivery due to ageing fleet, and requiring operational sustainability, customer focus and multi-modal integration. Fragmented institutional roles and responsibilities and limited funding and investments – CAPEX and OPEX also are of concern.

To secure development financing for buses, there are some pre-requisites for transit authorities. these include

- **Clarity in policy, planning, operations and management of urban bus services**, at national, state and city level with policy and strategic framework for operations and management which enable regulatory framework.
- **Clear obligation to deliver urban public transport services**: Urban public transport to act as a service, with supply and management which is customer-oriented, integrated, affordable and inclusive.
- **Performance, sustainability and viability of the bus service operations – models of operations.** The development must be holistic and comprehensive ecosystem development rather than just purchase and asset creation. There should be performance indicators for coverage, level of service, accessibility, fare, and supporting infrastructure. Additionally, the agency must be a self-sufficient agency to manage and scale up the system with skills/trainings.
- **Intermodal/multi-modal integration at different levels:** Integration of services across modes of transportation in a city are desirable. Physical integration of infrastructure should also be present including bus stops, bicycle docks, metro

exits points, pick-up/drop etc There should also be seamless Information integration flow enabling journey planning and management at customer front and also operations end. In addition to it, Fare sensitivity to urban bus services is critical, standalone as well as on an integrated basis to promote bus travel. Lastly, there is a requirement of a champion integrator to ensure coordination and optimisation of agency roles and responsibilities

- **Environment and social impact and outreach**: the impact in terms of green fuel technology, their management is critical, climate impact and environmental sustainability in terms of reductions of emissions, GHG and other emission, and the source of energy are all critical. Social impact on captive users and induced users, vulnerable groups, low-income groups, extended coverage to smaller towns and cities is to be known.
- **Capacity building and training - skill up-gradation:** Capacities of the agency for policy, planning, operations and management must be known, and whether they are interested in skill up-gradation, as it could be covered under the grant component along with the loan.

Funding and Financing Sources

Funding and financing for bus services can be accessed through different means like government funding – capital investment, subsidy, viability gap funding; private sector investments and by public-private partnerships. International Development Financing is going to support the bus sector in future. This support isn't necessary for CAPEX investment, but also for innovative models.

International Development Financing – Official Development Assistance (ODA)

Official Development Assistance (ODA) can be accessed through multilateral Institutions and bilateral institutions. And the key features are low financing costs with not only reduced interest loans but longer tenures. Grant assistance to optimise operational sustainability and planning and international knowledge exchange for capacity building bringing in new technology and skill upgradation.

Under the Indo German cooperation, giz, the technical arm, is already carrying out the activity and KFW the financial arm supports the ODA loan as well as grant assistance for operational sustainability. With the green urban mobility partnership, KfW is looking forward to invest around 9000 crores in the bus sector and other green mobility sectors.

5.5 Bus financing and need of innovation in it, SMMR Project

The project "Sustainable Design of Urban Mobility in Middle-Sized Metropolitan Regions" SMMR supports four metropolitan regions across Cambodia, Vietnam, Laos and Thailand in their ambitions to create metropolitan mobility planning procedures.[5]

The SMMR project is a sustainable urban mobility project. The approach is to avoid shift and improve. Avoid long distances to get all things done with integrated

[5] https://smmr.asia/

planning, shift to most efficient mode with good governance, and to improve the sustainability of each transport mode with smart tech and design.

The project financing including business plan, capable organisation, track records and project ideas along with urban mobility including sustainable urban mobility plan, Metropolitan transport executive, pilot actions, good practices example, meet together to apply for funding at the funding institutions.

Farebox revenue is the main revenue that any transportation industry must-have. However, to meet the cost of the operations, it must include marketing as well, and improve products, change fare pricing, check operations, hire the right people and groom them, to make sure right processes are followed. If still the cost is not covered, then include ancillary business and look into subsidies.

However, there are scenarios where there can be a wasteful subsidy when the subsidy is to fulfil the wasteful operation of the transport authority. It can be called a diversion of taxpayer money, which rather than going to environmental and social sustainability, is going to just ensure the economic survival of public transport. The quality bus partnership states that public policy and spending should not compensate for the operating deficit but create conditions for operating benefits. It is important to avoid the wasteful subsidy scenario. To do the same the public investment should follow the avoid, shift and improve strategy. To increase the farebox revenue, the focus must be shifted to the transportation system, its regulation, concessionary fares, spatial planning, capacity building, creating mobility plans, and finally on the pilot project.

A good Transportation system may feed to the ancillary business, which can further maintain sustainability hence completing a full circle, and becoming sustainable from all three points of view including environment social and economic.

In this direction, it can be said that focus on transit-oriented development must be given, which can help in improved operating conditions and support ancillary businesses. TOD would also benefit the citizens, in reducing dependency on driving, reducing carbon footprint, stimulating the local economy, providing better access to Urban and Suburban areas, better access to jobs, and revitalizing urban areas.

6 Program of the seminar

Day 1: 24 August, 2020

11:30-12:15 08:00- 8:45 CET	**Inaugural Session** ➢ **Welcome Address– Mohamed Mezghani,** Secretary General, UITP ➢ **Keynote Address- Hon'ble Minister Shri Nitin Gadkari,** Ministry of Road Transport & Highways and Ministry of Micro, Small and Medium Enterprises ➢ **Vote of Thanks- Rupa Nandy,** Head of UITP, India

12:15 - 13:15 08:45-09:45 CET	**Plenary Session: Covid-19 impact on bus sector and the road to recovery** **Moderator: Ange Anczewska, UITP Australia and New Zealand** ➢ **Director,** Department of Transport Victoria, Australia **– Ms Kim Schriner** ➢ **Managing Director-** KSRTC, **Mr Shivayogi C Kalasad** ➢ **Managing Director and CEO-**MP Enterprises **– Mr Abhishek M Pathak** ➢ **Managing Director** CRUT, Odisha **Mr Arun Bothra**

Day 2: 25 August, 2020

13:00 - 14:30 09:30-11:00 CET	**Technical Session I: Innovation, digitalisation and AI in bus operations** **Moderator: Henriette Cornet, Knowledge and Innovation, UITP** ➢ Data driven performance improvement in bus operations- case Study- **Luc Van Wijngaarden, Zight,** Netherlands ➢ Implementation of digital payments in MSRTC- **Rahul Toro, MSRTC,** India ➢ Integrated ticketing platform for seamless mobility in South Korea- **Joanne Yu**, **T Money Co Ltd**, South Korea ➢ Factors that impacts automatic fare collection projects in India– **S Srinivas AUM Infotech,** India ➢ Transitioning to Mobility as a Service – **Guido Di Pasquale , UITP**, Belgium

Day 3: 26 August, 2020

17:00-18:45 IST 13:30-15:15 CET	**Technical Session II : Planning and deployment of electric bus system** **Moderator: Eleonora Pazos, Head of Latin America, UITP** • E-bus story so far-Learnings from FAME I and II: **Ravi Gadepalli, UITP, India** • Barriers and enablers for e-bus implementation in India**- C Shikha, BMTC, India** • Implementation and promotion of the e-bus fleet and its policy in Chille- **Juan Carlos Gonzales, MTT, Chile** • Training needs assessment for e-bus in India- **Laghu Parashar GIZ, India** • Electric Buses of present and future- **Amit Kekare, Siemens, India** • Key elements for decision making in e-bus operation – **Marcello Gargaglione, CUTCSA, Uruguay**

Day 4: 27 August, 2020

14:30- 16:00 11:00-12:30 CET	**Technical Session III : Governance and financing instruments to sustain bus operations** **Moderator: Sue Chan – Head of Asia Pacific, UITP** • Data driven performance and contract monitoring – **C K Goyal,** DIMTS, India • Public transport service contracts-Learnings from Europe and approach for India – **Guido Bruggeman,** MELA LANKA, Sri Lanka • Governance and performance monitoring through tech integration-**Rajiv Aggarwal**, Uber, India • Improving readiness of government bus operators to attract low cost financing**-Swati Khanna KfW,** India • Bus financing models: Need for innovation- Joachim Bergerhoff, Team Leader SMMR Project, Cambodia

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