SHAKTI
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Road-Map for Bus Fleet and Infrastructure Development for State transport Undertakings (STU)

2019

MSRTC

SGArchitects

ROAD-MAP FOR BUS FLEET AND INFRASTRUCTURE DEVELOPMENT FOR STATE TRANSPORT UNDERTAKINGS (STU)

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1 Context

Most STUs in India are unprofitable and remain dependent on State support for sustaining operations and meeting fleet replacement or augmentation and infrastructure development or upgradation requirements. Since support for a continuous loss-making undertaking is often hard to access even from the State budgetary machinery, State Transport Undertakings (STUs) in India focus primarily on sustaining current operations, with limited resources at hand. They find themselves unable to direct effort towards meeting the increasing current demand (due to increase in population and affordability) and potential demand (potential to shift from other modes of transport). As such little or no studies are undertaken by these agencies to understand and address demand trends, supply gaps and sector status (such as demand catered by competing modes). Thus, they may not be ideally positioning themselves to cater to future requirements and meet current and future challenges to their business. In such a scenario, STUs may find themselves unable to reduce losses, making access to capital even more difficult and pushing the STUs in to a deteriorating cycle.

A case in this argument is Jammu and Kashmir State Road Transport Corporation (JKSRTC), which over a period has deteriorated to a level where it currently caters to less than 1% of the trips in the State with just over 300 operational buses. While this situation threatens the existence and viability of multiple STUs in India, the consequences can be far reaching. STUs serve as the backbone of mobility in India and provide the only mode of accessibility for remote villages and towns, especially on unprofitable routes. Additionally, lack of bus based public transport will lead to current and potential trips to shift to unsustainable private transport. To address the current problems faced by STUs, they need additional capital and technical investments, which needs to be planned for. To tap in to potential financing and/or funding resources the STU's need a business plan which makes a case for these investments (for fleet and infrastructure upgradation, etc.). Such investments will allow STU's to become profitable through optimization and by achieving strategic investment in infrastructure and fleet augmentation to allow an increase in its share of bus trips. This mandates the need for a long-range plan backed by a vision, and a roadmap to achieve that vision in both the long and the short term.

1.1 Study Background

However, to affect the overall revamping and improvement in the financial health of STUs, simple induction of fleet may not be enough. What is required is a detailed understanding and action on fleet, operations, service and infrastructure requirements, over a longer term. To achieve this, STUs require to focus on developing long range development plans as well roadmap to achieve the goals set in the development plans. Both the central government and the Association of State Road Transport Undertakings (ASRTU) have set up challenging goals for the STUs and are offering to support them in achieving the same. As a part of this initiative, a study was undertaken to demonstrate a potential approach which may contribute to reviving and repositioning bus based public transport in India. This approach included developing a long range (33 year) plan for three STUs – JKSRTC, Andhra Pradesh State Road Transport Corporation (APSRTC) and Maharashtra State Road Transport Corporation (MSRTC).

This roadmap development exercise provided a quantified and comparative, scenario-based data for use by decision and policy makers and seeks to demonstrate both the methodology and the utility of producing a road map for development of STU's. Two critical objectives of the study included the development of long-range plans for three partner STUs in terms of recommended fleet size, land requirement, annual budgetary provision, staff strength, etc.; and development of recommendations

for improvement of the health of STUs in India. The estimation and projection are governed by a current condition and expected scenario. Current conditions are defined by current data such as existing fleet strength, number of trips catered, fleet age, etc., while scenarios are defined by a vision to be achieved in horizon year including desired mode share, overall route length, total number of routes, desired efficiency, desired occupancy, etc. Because estimation of operational, fleet and infrastructure requirements for STUs in multiple scenarios involves complex calculations, the roadmap is derived based on modelling STU's fleet requirement using a spreadsheet-based model developed by SGArchitects, Delhi. It is expected that the outputs from the tool will contribute to an informed short, medium and long-term planning to achieve the vision and the goals and STU's will be able to use the findings of this study, to tap additional resources and funds.

This report presents the findings from the long-range planning study. It presents the study scope and methodology of the study, a description of the spread sheet-based tool used in the study, a discussion on tool outputs for the three partner STUs and a discussion on the proposed action plan for improving the health of STUs in India.

2 Scope and Methodology

The scope of this study was limited to development of long-range road map for two to three Indian STUs. The methodology was designed to achieve this scope. This section details the scope and methodology of this study.

2.1 Scope

This study has been undertaken to fulfil the following scope of work:

1. To estimate the performance of the partner STU's in the future based on past trends. These estimates shall be made against key performance indicators such as demand catered, mode share, fleet strength, operational efficiency, financial efficiency, etc.
2. To estimate the future requirements for the STU's to achieve the desirable scenario. These requirements are in terms of parameters such as fleet size, land requirement, depot and terminal infrastructure development requirement and investment requirement.
3. This data should be useful for STU's to develop a long-term plan for investment and efficient asset utilization. For example, with the knowledge of annual budgetary requirement, the STU's can plan a long-term strategy for tapping funds both from the State as well from funding agencies such as World Bank and ADB. With the knowledge of annual additional land requirement, the current land bank with STU's can be utilized and the land that is expected to remain unutilized can be turned in to a source of revenue for a known time.
4. To develop a profitability or a loss reduction scenario for the Corporations. This scenario shall identify and quantify the steps that may be undertaken to achieve specific loss reduction targets for the organization.
5. To propose an action plan for influencing identified factors for loss reduction. This action plan should help implement strategies to achieve loss reduction targets estimated as a part of this study.

2.2 Methodology

The methodology followed for meeting the above objectives for the study is as follows:

1. Use the existing data reported by STU's to plot trends, to predict the consolidated performance of the STU over the next 33 years both in terms of meeting passenger demand and in terms of financial performance. This scenario is referred to as the Business as Usual Scenario (BAU).
2. In a BAU scenario, based on trends, projections shall be used to cater the future demands by STUs (in terms of number of trips).Using available data on population growth rate and other factors, future demand of trips will be projected in the State (including trips from other states) along with projected demand, based on trip characteristics (trip length, trip purpose, rural, urban). This will help in estimating the future demand more accurately as well gives the liberty to the STUs to estimate the trend by changing their existing data with some aggressive figures.
3. Estimate the future demand which STUs will cater while retaining the current mode. Compare this demand with the demand expected to be catered by the Corporation based on the current trend.

4. Based on this comparison, next step would be to generate an understanding and report it to the Corporation whether, the current trends in operational and investment factors will help the corporation to retain or expand its market share in the future.
5. Similarly, based on the current trends, estimates will be reported to the Corporation on the projected financial health of the Corporation.
6. Include levers for scenario building in a relevant tool and explain the possibilities of building different scenarios to the concerned STU officials. Subsequently use this information to develop a desirable scenario with STU officials. These tools include mode share, operational efficiency, staff to bus ratio, occupancy, average passenger trip length, average route length, etc.
7. Estimate the performance of STU's in a desirable scenario, both in terms of passenger trips it will cater (mode share) and in terms of financial performance.
8. Also estimate the road map to the desirable scenario, listing the requirements in terms of Fleet expansion, bus infrastructure (depot and terminal) development, associated land requirement, and investments required.
9. Develop a profitability scenario by modelling variations in critical factors such as occupancy, staff to bus ratio and fleet utilization. Using this annual loss reduction and efficiency improvement targets shall be generated.
10. Generate an action plan for influencing efficiency improvement and increase in patronage – factors that will contribute to loss reduction. This action plan identifies loss reduction strategies through literature review, detail actionable points such as planning, financing and implementation, and provide an indication of expected outcomes.

3 Fleet Estimation Spread-sheet

The fleet estimation tool has been designed to assist State Transport Undertakings (STU) in projecting annual demand as well operational, fleet, infrastructure and budgetary requirement in different scenarios up to the horizon year. The following section presents the spreadsheet-based model architecture, functionality, data input requirements, estimation methodology, etc.

3.1 Model Architecture

The long range planning for the three partner STUs has been undertaken using a spread sheet-based model with three basic elements – a dashboard which serves as a user interface and data input module, a default sheet, which provides a scenario building interface and an output sheet which presents outputs as both as numbers and graphs. The model architecture is based on an annual projection/estimation basis and it generates annual outputs for a 33-year period from the date of input. It also allows users to use older data (older than the year of estimation), and projects these to the current date (to be further used for future projections) based on growth rates provided by the user. The model has been designed to provide macro or state level outputs (for both inter district and intra city operations), however it can also be tweaked to provide district level outputs.

3.2 Model Functionality

The model uses a series of validated algorithms, input values and default values to generate output for each successive year, till the defined horizon year. Each year estimates form the input for successive year estimates, thereby generating annual output values for 33 successive years, which are then presented as a table and graph for each of the outputs. As presented in Figure 1, the tool estimates a total of 37 outputs (*Refer- Annexure 4* : ranging from annual budgetary requirements for fleet and infrastructure to new buses to be purchased, budget required and profit after purchase. To generate the outputs, the model requires a list of data inputs along with assumptions (such as expected/desired mode share, composition as well characteristics of trips, etc.) which defines a scenario. The user is required to insert the data in the dash board tab and can access the results in output tab. The data input in dashboard has been designed keeping in mind the easy availability of data with the STU's and from other sources such as census. The user defines the current year and the data year. The model then projects the data from the data year (data such as census data is typically a historic data) to the current year and this is used in all output estimates. A total of 82 data inputs (*Refer Annexure 1*) are required to be provided by the user. The assumptions used for the calculations and projections are separately listed under default tab which includes a list of default values used in estimating the output values. These values are based on standard accepted norms and are editable by the user. However, changes to these values are required only when different scenarios need to be generated and compared. A total of 143 default values has been used by the model (*Refer Annexure 2*). This includes targeted mode share, annual rate of change, fleet and infrastructure development cost, etc.

The list of inputs is presented in *Annexure 1*, list of default values is presented in *Annexure 2* and the list of outputs is presented in *Annexure 4*, respectively

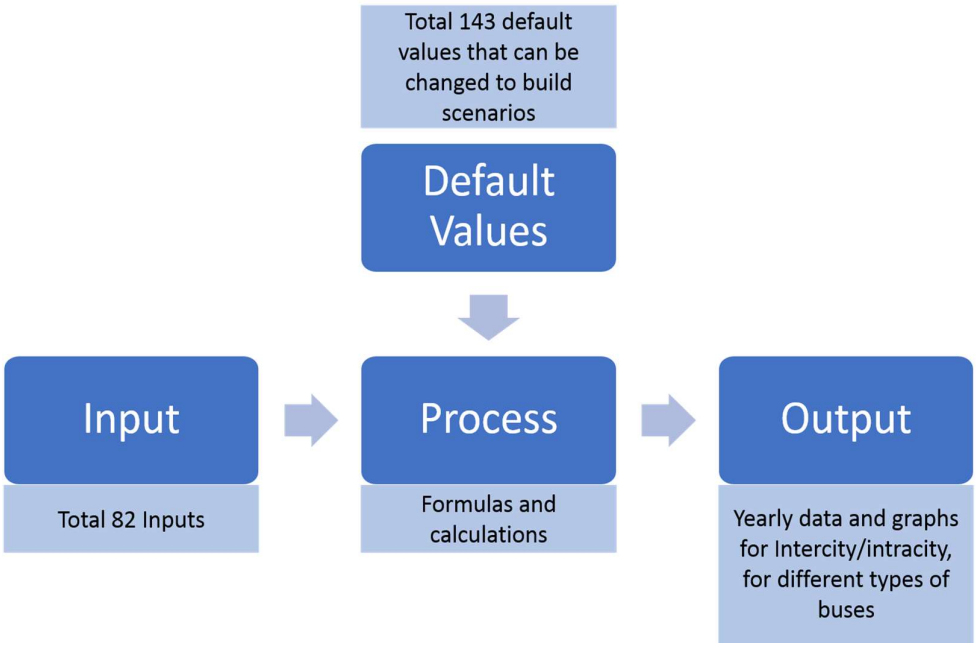

Figure 1: Fleet estimation tool- Working and Methodology

3.3 Data Inputs

The fleet estimation model requires a series of secondary data inputs. Based on this data the tool computes the projected scenarios. The two broad categories of data required for the tool and their use in output estimation has been described below.

1. **Latest census based demographic data from the State** - This data is used to project demographic profile of the state (such as population data, urbanization, etc.) over the next 33 years. This helps generate the overall demand in terms of daily trips. This is further bifurcated as intercity and intra city trips, trips by different modes, trips by purpose and trips by length. Such bifurcation allows application of trip characteristic specific growth rates to generate more realistic projections
2. **Current bus fleet data which are being operated by the STU** - This includes details on fleet size, fleet age, average occupancy, efficiency, fleet utilization, etc. Current fleet data (of STU) is used to estimate expected fleet size for the state over the next 33 years in a business as usual scenario. This when compared to the estimated fleet requirement in a defined scenario (say based on a defined expected mode share in the horizon year) over the same period will provides the expected gap required in operational bus fleet on an annual basis.

However, some of the data is not directly reported by STU's and neither readily available from secondary sources. This includes, average passenger trip length, average kilometres operated by per bus per day, average one-way trips per bus per day, average route length, etc. The breakup of the data in these values is essential to include levers in the tool for scenario building. Even though these data are not directly reported, it can be derived from available data.

3.4 Basis of estimation and projections

The objective of the fleet estimation and road map development exercise is to estimate the annual fleet requirement along with associated investment and infrastructure development requirement over the next 33 years. Infrastructure requirement is dependent on the fleet size and the existing gap in infrastructure availability. Therefore, if the requirement of fleet size is known, then the requirement for annual investment and infrastructure development can be determined. The fleet estimation model generates estimate of fleet size required in each projected year, based on expected bus trips, average passenger trip length, expected average occupancy, expected vehicle utilization and expected fleet utilization.

All other outputs are generated based on this projected fleet size. This includes staff requirements, Infrastructure requirements, land and budget requirements. Average daily bus trips are estimated based on population (urban and rural) of the state, growth rate (urban, rural and tourist) and the total trips (non-work, work and education) catered. Figure 2 presents basis of the fleet estimation and the components and data inputs involved in the process.

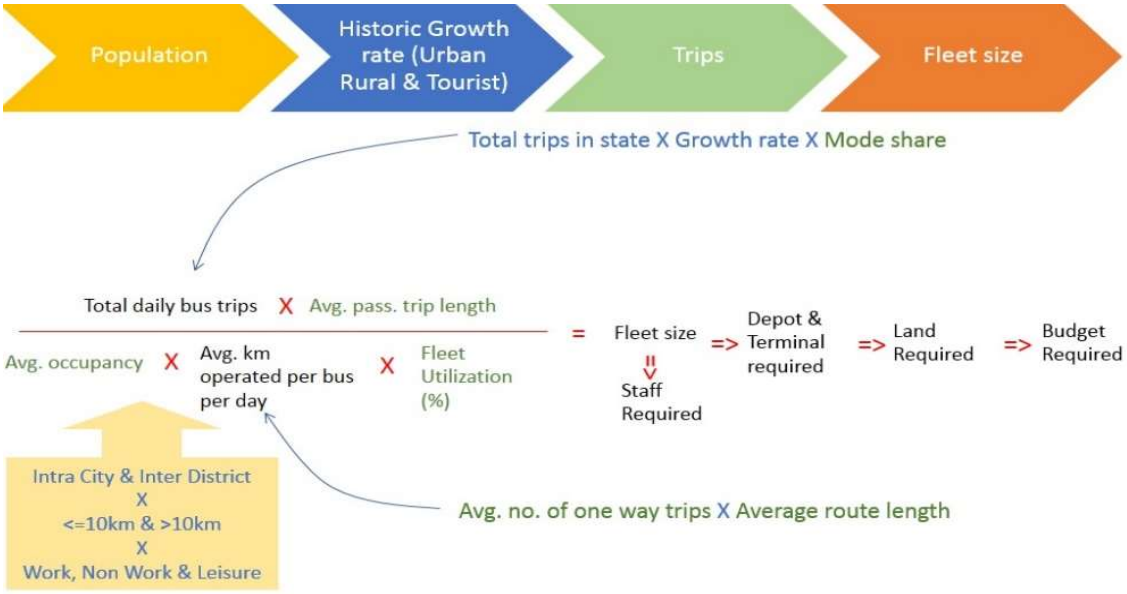

Figure 2: Fleet estimation Tool- Basis of estimation

3.5 Study Approach and task undertaken

The aim of the study was to develop a long-range roadmap for partner STU's. The fleet estimation model was used to project the fleet, budgetary, staffing, operational and infrastructural requirements for these STU's. As an initial step, historic trends were documented for the partner STU's and basis of data for the period 2007 to 2017. This trend was applied to 10-year-old data, and model outputs generated. The modelled output for 2017-2018 was validated with the current year data provided by the STU. Required adjustments and calibrations were made in the model (through adjustments of default values) to match projections with the current year data. The calibrated and validated model was used to project data from 2018 up to 2051 (33-year projection). This data included performance

indicators in terms of fleet size, fleet utilization, vehicle utilization, and passenger carried per day, number of routes etc.

Additionally, insights from interactions with STU officials has been applied to define the vision for the STU in horizon year (desired mode share, vehicle utilization, efficiency, etc.). Based on the defined requirements of the partner STU's and current year data, three broad future scenarios are modelled. These are:

1. **Business as usual scenario** - forecasted estimates based on the current trend of the STU.
2. **Mode share retain scenario** - current mode share is retained in the future i.e. the current STU mode share remains constant up to 2051.
3. **Desirable Scenario** – Projection of fleet, budgetary, staff, operational and infrastructural requirements for STU's, based on the desirable vision defined in consultation with the STUs.

In the business as usual scenario, mode share is an output derived based on number of trips that may be carried by the available fleet every year – where the available fleet is estimated based on historic fleet growth trend. In the mode share retain scenario, fleet is estimated not based on historic trend but based on requirement to carry the number of trips estimated for each year. The target trips for each year were calculated using the current mode share and applying it on the total trips estimated in the state for each year (using population growth projections). The mode share for different trip types in the current year was input as target mode share - applied with no rate of change in the default values tab. For desirable scenario, the vision of the STU's were discussed with STU officials. This included STU's future targets to be achieved in terms of mode share, fleet utilization, vehicle utilization, load factor etc. Based on the inputs received from the STU's, projections were derived from the model.

It is known that factors like percentage load factor, fleet utilization, reducing staff to bus ratio etc. can influence loss reduction for STU's. Thus, by modifying these factors in the desirable scenario, a profitability scenario was developed for partner STUs. This scenario included a proposed phased modification of the identified trigger factors for achieving loss reduction.

4 Model outputs for the three partner STUs

This section presents the spread sheet-based model outputs for the partner STU's – JKSRTC APSRTC and MSRTC. While model outputs were generated for a single scenario to revive JKSRTC, multiple scenarios were developed for APSRTC and MSRTC, and model outputs in each scenario compared to derive the long-range plan for these STUs. The scenarios for long range plan development of APSRTC and MSRTC was generated in a conservative approach, whilst critical operational parameters such as load factor, fleet utilization, operational efficiency (vehicle utilization) and staff to bus ratio etc., were retained as existing or modelled in line with historic trend. Only factors related to passenger trips, i.e. demand were modified to measure the impact on capacity (fleet strength and infrastructure) requirements. However, an additional scenario, referred to as profitability scenario was modelled and presented to the APSRTS and MSRTC. This scenario documented the impact of tweaking operational variables of the overall profitability of the STUs. This section presents the key components of the long-range plan for the three STUs. It also compares the model outcomes in the profitability scenario developed for APSRTC and MSRTC.

4.1 Jammu and Kashmir Transport Corporation - JKSRTC

Jammu and Kashmir (J&K) State Road Transport Corporation (JKSRTC), is the state government agency that provides passenger (on both intra city and intercity routes) and freight transport services in Jammu and Kashmir and the adjacent States. Due to high altitude and adverse geographical settings the bus system here has been the lifeline of the transportation in the State. These factors underscore the need for a more modern and efficient bus service in J&K. An assessment of current JKSRTC operational and financial data suggested that the corporation is burdened by an ageing fleet of vehicles and lack of capacity to cater to current demand. For example, bus operations lack adequate staff strength and operate on a much-reduced fleet size, which has led to high levels of operational inefficiencies leading to poor financial performance. Similarly, nearly 80% of vehicles in the fleet of trucks running freight services for the corporation require immediate replacement. While freight operations are generating operational profits for JKSRTC, the passenger services form the backbone of JKSRTC services - though currently is a loss-making proposition. To address this problem, the project team undertook telephonic and web-based interaction with JKSRTC officials and based on the data received separate "Revival cum Upgradation Plan" for the passenger and freight services operated by JKSRTC were developed.

Regarding passenger bus services a long-range investment plan was generated focussing on augmenting fleet, infrastructure and staff strength for the corporation. To develop this plan, current population growth trends have been used to forecast future population and estimates of trips. Additionally, insights from interactions with JKSRTC officials as well web resources (2011 census data) were applied to generate an estimate of mode share in horizon year between different trip types (work, non-work and educational trips). Based on these a scenario based on desired but achievable mode shares and efficiency levels was developed based on inputs provided by JKSRTC planning team.

4.1.1 JKSRTC – Existing Scenario

The current data analysis revealed that in 2017, out of 89 lakh passenger trips made daily in the state of Jammu and Kashmir, 26 lakhs or about 29% trips are made by buses. Out of these bus trips only about 10,728 or about 0.1% (of total passenger trips in the state) trips were made by JKSRTC buses in 2017 and amounts to about 0.4% of total bus passenger trips in the State. This suggests that there exists enough scope for JKSRTC to expand its operations without risking reduced occupancy. Basis this

mode share scenarios for JKSRTC buses and private buses in the state has been defined using three inputs – current year mode share, desired mode share and rate of change for achieving the desired mode share. This has been presented in Table 1.

Table 1: Mode share scenario for JKSRTC bus operations

Intercity/ Intra City	<=10km/ >10km trip length	JKSRTC - current	JKSRTC - target	Other/private buses - current	Other/private buses - target
Intra city	<=10 km	0.15%	21%	26.43%	13%
	>10 km	0.06%	30%	42%	20%
Inter city	<=10 km	0.10%	15%	17.76%	12%
	>10 km	0.15%	38%	59.39%	25%

The annual rate of change for all operations and trip lengths has been considered as 6.0%.

JKSRTC owns around 255 trucks and another 700 goods vehicles in the fleet are hired. The corporation is currently recording an average of Rupees 60/km earnings from these operations against a cost of Rupees 55 per km, for the fleet owned by the corporation. However, the current fleet utilization for these goods vehicles is low at 80% and about 80% of the fleet is more than 12 years old and need immediate replacement. Additionally, the corporation intends to augment its own truck fleet to phase out hiring of goods vehicle over the next couple years at an annual rate of 20% per year. Additionally, it is expected that the overall staff strength augmentation for JKSRTC will result an improvement of truck fleet utilization at an annual rate of 15%.

4.1.2 JKSRTC – Model Outputs

Model outputs generated for JKSRTC suggest that to revive passenger and freight operations, a capital infusion in terms of support from the State, totalling to Rupees 849.28 crores[1] is required over the next six years, i.e. up to and including financial year 2022-23. This will allow JKSRTC to expand its overall (Bus + Truck) fleet size, expand operations, and improve operational efficiency, fleet utilization and occupancy to a level that financial year 2023-24 onwards the corporation shall be able to book profits. The overall profits before taxes and after investments in fleet and infrastructure development, shall increase gradually to Rs. 4066 crores in financial year 2050-51, starting with Rs. 46.02 crores in the financial year 2023-24(Figure 3). As per this road map, it is estimated that JKSRTC (both passenger and freight services) shall require an initial financial support in terms of capital infusion totalling to 338.82 crores up to the end of the financial year 2018-19. Details of findings from the long-range plan for JKSRTC have been presented below, separately for passenger and freight services.

[1] All future budgetary estimates are at current value of money and do not account for any inflation etc.

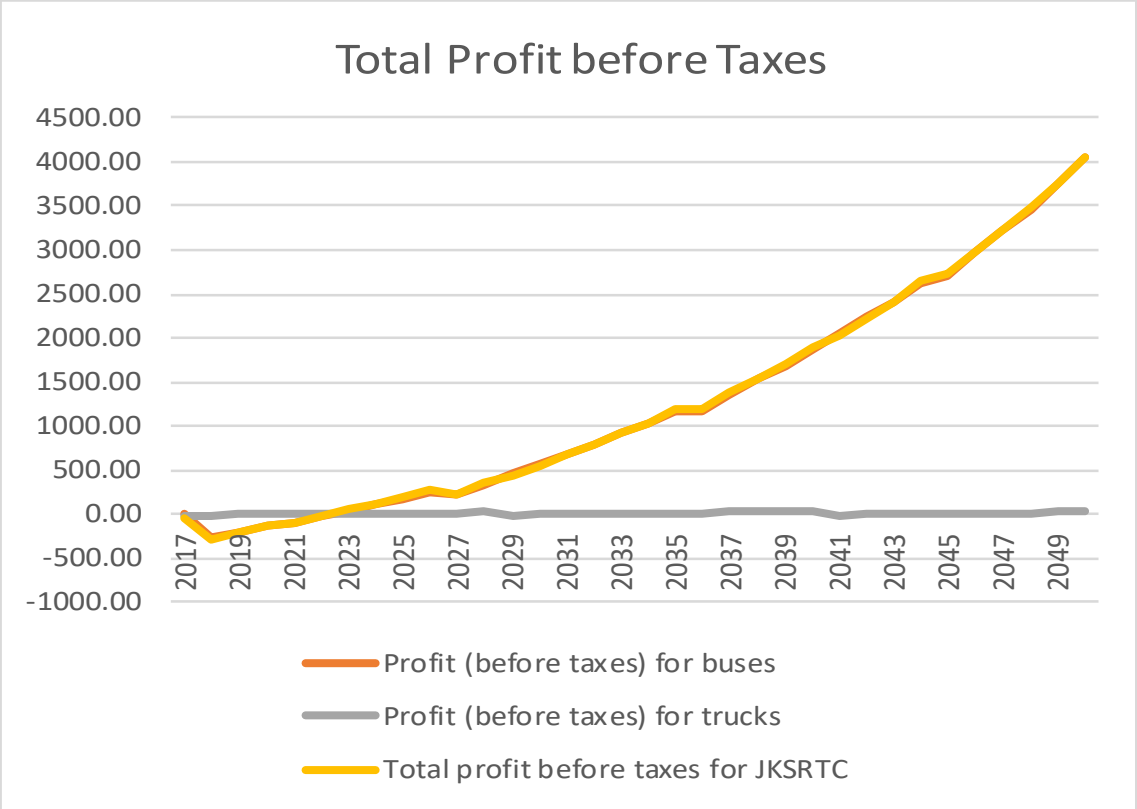

Figure 3: Overall (Bus + Truck) Profit graph – JKSRTC

4.1.2.1 Passenger

It is expected that the estimated infusion of capital over the initial six years shall propel the corporation on to a revival path, which in an optimistic scenario, is expected to result in a JKSRTC fleet size in excess of 11300 buses and 998 trucks by 2050-51. Total number of depots and terminal expected to increase to 143 depots and 202 terminals, by 2050-51. It is expected that operational efficiency will improve to 97% for both intra and intercity operations, fleet utilization (excluding stand-by fleet) shall touch 100% while occupancy level shall exceed 94% for intercity operations and 97% for intra city operations. Staff to bus ration of 4.1 shall be achieved by this target year with the cumulative staff strength exceeding 46,000. It is estimated that the resultant impact on JKSRTC operations shall result in total number of routes served will increase to 3,000 by 2050-51. Additionally, passengers will benefit from a reduced average waiting time of under 19 minutes on intra city routes and under 2 hours on intercity routes. By 2050-51, JKSRTC buses should be operating on 31.84 lakh cumulative kilometres every day, carrying over 53.7 lakh passenger trips daily. Thus, JKSRTC shall be self-reliant and profitable in the financial year 2023-24, with an expected annual operational profit of Rupees 39.11 crores (for buses) before taxes and after including all operational infrastructure development and fleet upgradation cost from bus operations for that year. With a sustained investment in staff strength and fleet size, it is expected that these profits shall continue to increase as operations expand. The estimated outputs for JKSRTC year wise have been listed in the Table 2

Table 2: Model Outputs – Passenger operations JKSRTC

S.no	Specific Expected Year Wise Outputs for bus operations	2017	2020	2030	2040	2050
1	Total Trips per day State wide in *Lakhs*	89	96	128	180	275
2	Total passenger Trips per day (JKSRTC) in Lakh	26.1	29.5	43.2	63.6	99
3	Expected Mode share in %	0,12	3.90	13.20	19.27	23.63
4	Total Routes	28	600	1546	2164	2997
5	Total Fleet	61	1440	4301	6986	11336
6	Fleet acquisition (Total Buses to be Procured in year including replacements)	3	347	611	868	1467
7	Cumulative staff strength *in numbers*	1046	4684	16366	27924	46070
8	Cumulative land under terminals and depots in Hectares	8.55	38.53	100.72	159.10	254.79
9	Total bus terminals by year	7	29	71	115	190
10	Total bus depots by year	3	15	43	70	114
11	Annual Budget in *in Crores* [2]	0	130	178	243	427
12	Expected annual Operating Cost *in Cr*	22.56	539.88	2049.57	4095.26	7699.66
13	Expected annual Earning *in Cr*	14.13	531.31	2784.05	6202.91	12176.77
14	Expected operational profit before taxes *in Cr*	-8.43	-8.57	734.49	2107.66	4477.11
15	Expected annual profit before taxes (Buses) *in Cr*	-8.46	-138.39	556.41	1864.81	4050.02

4.1.2.2 Freight

Additional investments are required to expand the truck fleet size operated by JKSRTC. It is estimated that truck fleet currently generates an annual profit of Rupees 4.5 crores for JKSRTC. However, investments required to purchase additional fleet to both replace the ageing fleet and to augment the same result in a cumulative requirement of 69.50 crores over the next five years up to and including financial year 2021-22. Following this, from the year 2022-23, JKSRTC truck operations shall be self-sustaining and generate operational profits before taxes and after investments (in additional truck fleet). It is estimated that these operational profits for truck operations for the year 2022-23 shall be Rupees 3.63 crore. A total of Rupees 51.80 crore investment is required to purchase new trucks till the end of financial year 2018-19. This will result in the purchase of 353 new trucks, increasing the truck fleet size for JKSRTC to 404 in this period. The estimated freight operations outputs for JKSRTC year wise have been listed in the Table 3

Table 3: Model Outputs – Freight operations JKSRTC

S.no	Expected Year Wise Outputs for JKSRTC Freight Services	2017	2020	2030	2040	2050
1	Total Fleet requirement *in Numbers*	255	618	958	995	998
2	Fleet utilization	80%	85.79%	93.19%	94.64%	94.93%

[2] Annual Budget requirement comprises of sum of Budget for Depot Development (Crore Rs.) + Budget for Terminal Development (Crore Rs.) + Budget for purchase of new buses (Crore Rs.)

3	*New trucks to be purchased in Numbers*	204	95	159	17	27
4	Budget required for new and replacement trucks *in Cr*	36.72	17.1	25.9	2.77	43.7
5	Annual Operating Cost *in Cr*	49.14	127.72	215.06	226.85	228.23
6	Annual Earning *in Cr*	53.61	139.33	234.61	247.48	248.98
7	Annual Profit *in Cr*	4.47	11.61	19.55	20.62	20.75
8	Profit after including investments in the fleet.	-32.25	-5.49	-6.39	17.85	16.37

4.2 Andhra Pradesh State Transport Corporation – APSRTC

APSRTC is a leading passenger road transport organization in the state of Andhra Pradesh. It operates 90% of the bus trips in the state covering city as well Mofussil areas with fleet size of 11713 buses (2017). The buses of the Corporation also ply to important towns and cities in the adjacent states.

4.2.1 APSRTC – Existing Scenario

The current data analysis revealed that the share of intercity trips is much larger than the share of urban trips catered by APSRTC resulting in a low urban mode share and high rural/regional mode share. It is expected that in the future with increasing urbanization, the share of rural/regional trips (as part of total trips made in the state) will reduce, leading to reduction in the current overall mode share (21%) of APSRTC. Table 4 presents the current intercity, intracity and overall mode share catered by APSRTC.

Table 4: Current Mode Share – APSRTC

APSRTC	Overall Mode share	Intercity Mode share	Intra city mode share
2018	20.99 %	33.65%	7.18%

This mode share coupled with the annual increase in trip demand estimates annual increase in fleet size as well annual cumulative fleet size requirement of APSRTC. The fleet size is expected to increase gradually from the current 11828 buses in 2018 up to 15980 by 2051 and decline in overall mode share from the current 21% to 16% (Figure 4).

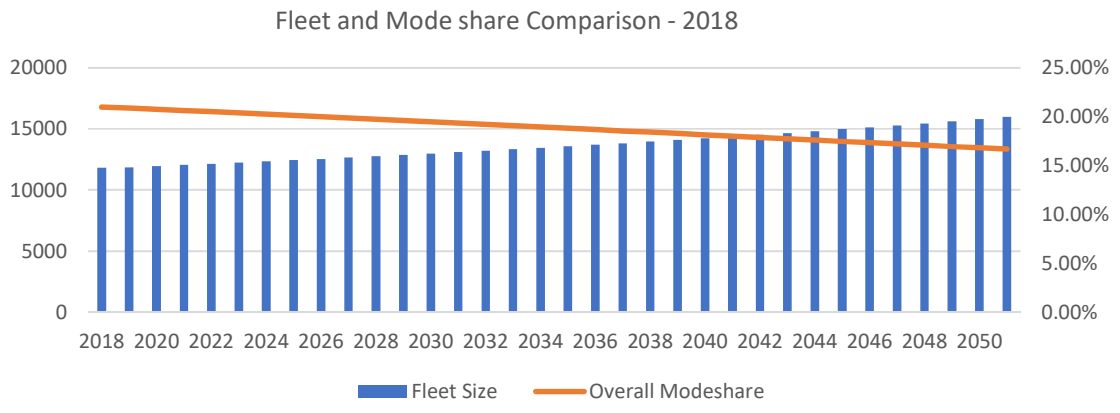

Figure 4: APSRTC Fleet and Mode share projection comparison

Three scenarios (Business as usual, mode share retain and desirable) as mentioned in above chapter (Fleet Estimation Spread-sheet, *Refer – section 3.5*) has been developed in the spread sheet model to judge the health and status of development of APSRTC. For the purpose, initially performance of the STU past 10 years (2007 - 2017) was studied. These performance trends formed a base of scenario building. However, as desired by APSRTC, the long - range roadmap incorporates an additional desirable scenario with an aggressive mode share of 30%.

4.2.2 APSRTC – Model Outputs

The spread sheet-based model projections suggest that by 2051, APSRTC would need to keep increasing its fleet strength. The outputs revealed a marginal increase in fleet size in business as usual and mode share retain scenario, whereas in desired scenarios, the drift is much higher. This is because in the desired scenario along with increasing number of buses, the overall APSRTC mode share is also increased to desired 25% and 30% respectively from the current 21% mode share.

Table 5: Scenario wise fleet projection – APSRTC

APSRTC Fleet size	2018	2051
Business as usual scenario	11828	15981
Mode share retain	11828	15028
Desirable with 25% mode share	11828	22645
Desirable with 30% mode share	11828	26537

In a business as usual scenario, APSRTC fleet strength will increase by 1.3 times by 2051of the present fleet size in 2018 (from 11828 to 15981 buses - Table 5). However, the rate of increase of the fleet size is not entirely aligned to the rate of increase in the trips in the state. This will result in decrease in overall APSRTC mode share. Additionally, the operational efficiency will continue to decrease up to 91.4% from the current 94% (this is based on the current trend). Due to reduction in Operational efficiency, the fleet availability for catering to existing trips also reduces in a business as usual scenario. The key outputs generated for scenario 1 – business as usual scenario have been presented in Table 6

Table 6: Scenario 1 –Outputs

S.no	Outputs – Business as Usual	2018	2020	2030	2040	2050	2051
1	Total trips per Day (State wide) in Lakh	316 .0	326.0	384.0	462.0	5680	580.0
2	Total passenger trips per day (APSRTC) in Lakh	66	68	75	84	95	97
3	Total Routes	3938	3845	3707	3911	4126	4148
4	Total Fleet	11828	11958	12988	14238	15801	15981
5	Fleet acquisition (Total Buses to be Procured in year including replacements)[3]	115	2512	162	361	2048	541
6	Number of terminals to be developed annually	1	1	2	1	2	1

3 Variation in the number of buses to be procured (in that year) is observed because this value includes buses required to be procured to replace an ageing fleet. Thus, the jump in number coincides with the year when a number of existing buses reach end of their life. This jump can also be seen in the annual budgetary requirements.

7	Total Bus Terminal by year	225	226	238	250	264	265
8	Number of Depots to be developed annually	1	2	1	1	2	2
9	Total Bus Depot by year	118	120	130	142	158	160
10	Cumulative Land under depots and terminals in Hectares	268	271	291	315	345	348
11	Annual Budget in Crores	45	617	56	108	522	159
12	Cumulative Staff strength in numbers	63045	63738	69226	75891	84221	85178

When the current mode share is retained into the future i.e. mode share remains constant up to 2050 (same as today), the model projects similar results/requirements (for APSRTC) as in scenario 1 i.e. Business as usual scenario. The tool projections revealed that by 2051 APSRTC fleet requirements will increase with a reducing operational efficiency (based on the current trend), in order to maintain the current mode share (for each trip type). Additionally, the number of routes also show a gradual declining trend. This is because of reducing vehicle utilization trend (due to reducing average operational speeds, etc.), while the mode share is constant. The key outputs generated for scenario 2 –mode share retain scenario have been presented in Table 7

Table 7: Scenario 2 –Outputs

S.no	Outputs – Mode Share retain Scenario	2018	2020	2030	2040	2050	2051
1	Total trips per Day (State wide) in Lakh	316.0	326.0	384.0	462.0	568.0	580.0
2	Total passenger trips per day (APSRTC) in Lakh	66.0	68.0	73.0	80.0	90.0	91.0
3	Total Routes	3955	3881	3634	3431	3401	3420
4	Total Fleet	11828	11907	12675	13644	14884	15028
5	Fleet acquisition (Total Buses to be Procured in year – including replacements)	115	2486	128	305	1958	449
6	Number of terminals to be developed annually	1	0	1	0	0	2
7	Total Bus Terminal by year	225	225	233	241	251	253
8	Number of Depots to be developed annually	1	1	1	2	1	3
9	Total Bus Depot by year	118	119	127	137	148	151
10	Cumulative Land under depots and terminals	267.9	270.0	284.9	303.4	326.6	329.3
11	Annual Budget in Crores	45	607	44	90	494	131
12	Cumulative Staff strength[4]in numbers	63045	63501	67560	72722	79330	80097

Two 'desirable scenario' were developed for APSRTC – scenario 3 and scenario 4. In scenario 3, the mode share is envisioned to be increased to 25% (from existing 21% today)and fleet utilizations is

4 This is based on the staff to bus ratio, retained as same for future years.

expected to increase to 100% (from 98% today), The model outputs for this scenario suggest that APSRTC fleet strength will increase with a reducing operational efficiency (as per current trend), to achieve the target mode share by 2051. Additionally, the number of routes also show a gradual increasing trend (as number of buses are increasing but the mode share is also increasing). The key outputs generated for scenario 3 – desirable scenario have been listed in Table 8

Table 8: Scenario 3 – Outputs

S.no	Outputs–Desirable Scenario(25%)	2018	2020	2030	2040	2050	2051
1	Total trips per Day (State wide) in Lakh	316.0	326.0	384.0	462.0	568.0	580.0
2	Total passenger trips per day (APSRTC) in Lakh	66.0	68.0	73.0	80.0	90.0	91.0
3	Total Routes	3938	3928	4144	4654	5144	5194
4	Total Fleet	11828	12283	15014	18223	22190	22645
5	Fleet acquisition (Total Buses to be Procured in year including replacements)	115	2675	489	750	2699	1205
6	Number of terminals to be developed annually	1	3	3	2	3	3
7	Total Bus Terminal by year	225	229	253	277	303	306
8	Number of Depots to be developed annually	1	2	3	4	5	5
9	Total Bus Depot by year	118	123	150	183	222	227
10	Cumulative Land under depots and terminals in Hectares	267.9	276.54	328.58	388.19	460.48	468.7
11	Annual Budget in Crores	45	681	163	235	721	363
12	Cumulative Staff strength in numbers [5]	63045	65469	80024	97128	118271	120697

In scenario 4, the mode share is envisioned to be increased to 30%The model generated similar outputs as scenario 3, with increase in fleet strength, reduction operational efficiency (as per current trend), and increase in number of routes. The key outputs generated for scenario 4 – desirable scenario have been listed in Table 9

Table 9: Scenario 4 – Outputs

S.no	**Outputs**–Desirable Scenario(30%)	**2018**	**2020**	**2030**	**2040**	**2050**	**2051**
1	Total trips per Day (State wide) in Lakh	316.0	326.0	384.0	462.0	568.0	580.0
2	Total Passenger trips per day (APSRTC) in Lakh	66.0	68.0	73.0	80.0	90.0	91.0
3	Total Routes	3938	3974	4394	5084	5743	5809
4	Total Fleet	11828	12466	16172	20529	25919	26537

5 This is based on the staff to bus ratio, retained as same for future years.

5	Fleet acquisition (Total Buses to be Procured in year including replacements)	115	2767	684	977	3081	1595
6	Number of terminals to be developed annually	1	4	3	3	3	4
7	Total Bus Terminal by year	225	231	262	293	326	330
8	Number of Depots to be developed annually	1	4	3	5	6	6
9	Total Bus Depot by year	118	125	161	205	259	265
10	Cumulative Land under terminals and depots in Hectares	267.9	279.98	350.10	430.50	528.15	539.27
11	Annual Budget in Crores	45	717	226	310	839	483
12	Cumulative Staff strength in numbers [6]	63045	66444	86197	109418	138147	141444

4.3 Maharashtra State Transport Corporation - MSRTC

MSRTC is a road transport service provider established by State Government of Maharashtra. MSRTC operates bus service in Maharashtra and neighboring states with a fleet size of 18634 buses, it covers more than 60 lakhs kilometers daily.

4.3.1 MSRTC – Existing Scenario

MSRTC plans to gradually cease urban bus operations to zero in span of 6-8 years' period. Following this, it shall only operate non-urban and inter-city services. Thus, it is expected that MSRTC mode share in intercity passenger trips will increase from the current 18.68% in 2018. However, since intracity operations will cease to exist, the overall mode share of MSRTC (7.57% in 2018) will be declining. Based on the historic trend of expansion of intercity operations as well trend of fleet strength expansion for these services, it is estimated that the fleet size and routes are expected to increase gradually over the years. Asper the past trends fleet size is expected to grow from 15352 in 2007 to 31492 in 2051 and routes will increase from 16482 in 2007 to 32872 in 2051.

4.3.2 MSRTC – Model Outputs

Based on the requirements of MSRTC and existing current year data, three broad future scenarios were modelled in the tool. Like APSRTC, similar approach was opted to generate outputs for MSRTC. The model outputs revealed that in the business as usual scenario mode share in intercity passenger trips will increase from the current 18.68% in 2018 to 21.97% in 2051. However, since intracity operations will cease to exist, the overall mode share of MSRTC will be declining marginally from 7.57% in 2018 to 7.05% in 2051. When the current share of rural regional intercity passenger trips is retained in 2051 (i.e. at 18.68%), the overall mode share (in the state) of MSRTC reduces from 7.57% in 2018 to 6.02% in 2051. Whereas if the MSRTC mode share in intercity passenger trips, is targeted to increase up to 25% (in a 'desirable scenario') in 2051, the model output suggests, a marginal increase in overall mode share from 7.57% in 2018 to 8.01% in 2051(Table 10).

Table 10: MSRTC Mode Share Comparison for Intercity and Intracity buses (All Scenarios)

6 This is based on the staff to bus ratio, retained as same for future years.

Mode share	Business as usual Scenario		Mode share retain Scenario		Desirable scenario	
Year	Intercity mode share	Overall mode share	Intercity Mode share	Overall mode share	Intercity mode share	Overall mode share
2018	18.68%	7.57%	18.68%	7.57%	18.68%	7.57%%
2051	21.97%	7.05%	18.68%	6.02%	24.94%	8.01%

The model outputs suggest that by 2051, MSRTC fleet strength will almost be double of the present fleet size, and vehicle utilization will increase by a total of 3.17% in a 'business as usual scenario' (based on the current trend). As fleet utilization is constant (at a rate of 90%) the overall mode share is expected to increase. The key outputs generated for scenario 1 – 'business as usual scenario' have been listed in Table 11

Table 11: Scenario 1 – Outputs

S.no	Outputs – Business as Usual	2018	2020	2030	2040	2051
1	Total Trips per day (MSRTC)	3.52 Cr	3.60 Cr	3.99 Cr	4.45 Cr	5.09 Cr
2	Total Passenger trips per day (MSRTC) in Lakh	67.9	68.3	79.8	93.7	112.8
3	Total Routes	19006	19597	23100	27209	32868
4	Total Fleet	18954	19416	22273	26156	31492
5	Fleet acquisition (Total Buses to be Procured in year including replacements)	318	3527	602	1087	1641
6	Number of terminals to be developed annually	6	6	8	9	11
7	Total Bus Terminal by year	386	398	468	549	661
8	Number of Depots to be developed annually	3	4	4	5	6
9	Total Bus Depot by year	184	190	223	262	315
10	Cumulative land under terminals and depots in Hectares	7.42	7.19	8.27	9.83	12.92
11	Annual Budget in Crores	122	890	196	276	413
12	Cumulative staff strength in numbers	1983	1921	2209	2625	3452

In case if mode share is retained the, model outputs suggest that by 2051 MSRTC fleet strength will need to be increased by almost 30% with an increasing vehicle utilization (as per current trend), to maintain the current mode share. The key model outputs generated for scenario 2 – 'mode share retain scenario' have been listed in Table 12

Table 12: Scenario 2 – Outputs

S.no	Outputs – Mode share Retained	2018	2020	2030	2040	2051
1	Total Trips per day (MSRTC)	3.52 Cr	3.60 Cr	3.99 Cr	4.45 Cr	5.09 Cr
2	Total Passenger trips per day (MSRTC) in Lakh	67.9	67.5	74.9	83.9	96.2
3	Total Routes	19006	19382	21683	24348	28039

4	Total Fleet	18954	19208	20907	23406	26866
5	Fleet acquisition (Total Buses to be Procured in year including replacements	318	3422	378	814	1177
6	Number of Terminals to be developed annually	6	5	5	6	7
7	Total Bus Terminal by year	386	394	439	492	564
8	Number of depots to be developed annually	3	2	2	3	4
9	Total Bus Depot by year	184	187	209	234	269
10	Cumulative land under terminals and depots in Hectares	7.42	4.74	5.34	6.32	8.46
11	Annual Budget in Crores	122	850	123	233	333
12	Cumulative staff strength in numbers	1983	1266	1428	1689	2261

If the mode share is increased up to 25% by 2051 in a 'desirable scenario', the model generates similar results/requirements as 'business as usual scenario'. The fleet strength will increase by around 5000 buses in a 'desirable scenario', as compared to an increase of 12000 buses in 'business as usual scenario'. This is because increase in percentage load factor of 72% and 100% vehicle utilization. The key outputs generated for scenario 3 – 'desirable scenario' have been listed in Table 13

Table 13: Scenario 3 – Outputs

S.no	Outputs – Mode share Retained	2018	2020	2030	2040	2051
1	Total Trips per day (MSRTC)	3.52 Cr	3.60 Cr	3.99 Cr	4.45 Cr	5.09 Cr
2	Total Passenger trips per day (MSRTC) in Lakh	67.9	69.1	84.8	103.2	128.1
3	Total Routes	18847	18951	19418	19721	20255
4	Total Fleet	18928	19179	20500	22258	24604
5	Fleet acquisition (Total Buses to be Procured in year including replacements	292	3403	340	647	1059
6	Number of Terminals to be developed annually	6	4	4	3	9
7	Total Bus Terminal in year	386	393	431	467	517
8	Number of depots to be developed annually	3	2	2	2	4
9	Total Bus Depot in year	184	187	205	223	246
10	Cumulative land under terminals and depots in Hectares	6.82	4.30	4.09	4.18	9.62
11	Annual Budget in Crores	112	843	106	180	312
12	Cumulative staff strength in numbers	1381	777	925	1025	2456

4.4 Profitability of the STU's

The fleet estimation study for APSRTC and MSRTC, not only estimated the future fleet and infrastructure requirements (based on current or past operational characteristics) but also projected the profitability/loss-reduction scenarios (after tweaking operational characteristics). The desirable scenarios modelled for the partner STU's show losses in the current year that tend to increase exponentially by 2051. The variation in losses between different years is because of variation in fleet purchasing/replacing patterns between the years. In the years when a significant fleet size reaches its age limit, additional funds are required to replace the same, thus increasing losses. The model projected that these losses can be expected to decrease by 2051 by tweaking five parameters which pivots the earning and cost incurred by STU's and thus affected the profitability. By influencing these factors objective of minimizing STU losses can be achieved. These include:

1. **Staff to bus ratio**
2. **Fleet utilization**
3. **Average occupancy (or percentage load factor)**
4. **Average passenger trip length**
5. **Operational efficiency**

Out of the above listed loss reduction factors, passenger trip length and operational efficiency do not have a clear benchmark and thus have not been tweaked as a part of this study. The other three factors, i.e. fleet utilization, average occupancy (percentage load factor) and staff to bus ratio were altered for improvement. However, in case of APSRTC, the model output revealed that APSRTC is expected to attain 100% fleet utilization in the future as per current trend. Thus, to show the impact in loss recovery of APSRTC, operational efficiency was tweaked along with bus to staff ratio and average occupancy. In order to achieve a better understanding of contribution of each factor in achieving profitability, modification of the parameters was undertaken sequentially. This order of modification was based on the quantum of contribution in improving STU earnings. In the business as-usual scenario and mode share retain scenario, the required state support remained similar whereas in the desired scenario, the state support increased with corresponding increase in operational cost and revenue. As changes are applied to the three operational characteristics, a reduction in state financial support can be observed and quantified (in the projections). This generated an additional scenario – 'profitability scenario' for APSRTC and MSRTC.

4.4.1 Profitability Scenario for APSRTC

Profit/loss estimates can be classified as operational loss and state support. Here operational loss is are the losses in undertaking scheduled operations, while state support also accounts for additional investment requirement on account of fleet procurement and infrastructure development. This is because the financial burden on the State because of the STU is on account of not just operational losses but also on account of investment requirements in the STU.

Current annual State support to APSRTC is estimated at Rs.1668.0 crores in a desired scenario and the outputs generated by the tool projects this to increase to Rs. 2680.11 crores. Discussed below are the model outcomes for APSRTC, after sequentially tweaking operational parameters on APSRTC scenario 3 ('desired scenario' with 25% mode share).

1. The target value of average occupancy is changed for intra and intercity operations from 67% and 68% respectively to 80% for both, in the model. While the rate of change is increased from 1% to 2%. By doing so, average occupancy for intracity operations increases from 67.26% in

2018 to 73.46% in 2051 and for intercity from 68.24% in 2018 to 73.96% in 2051. Consequently, the annual loss estimate reduces from Rs. 2680 crores in the 'desired scenario' to Rs. 1712 crores in 'profitability scenario' in 2051.

2. Over the changes in occupancy, modifications of staff to bus ratio were applied in the model. APSRTC currently has a bus to staff ratio of 5.33. This is slightly higher than what is prescribed in literature for the subcontinent (5.2), but significantly higher than what other countries can achieve (4.2 for Singapore). Following this, firstly the target bus staff ratio was reduced to 5.2, with an annual rate of change of 2% in the default tab of fleet estimation tool and the impact over profitability was noted. This achieves a staff to bus ratio of 5.26 in 2051. This further reduces the losses to Rs. 1712.34 crores by 2051
3. Over the changes in occupancy and staff to bus ratio, modifications in operational efficiency were applied in the model. The target operational efficiency value was changed from 84% to 90% in the model. This led to operational efficiency for intra city services reaches a value of 92.2% from 90.7% in 2051 and for intercity services, the value changes to 93% from 91.4% in 2051. The result is a further reduction in annual loss estimate to a value of Rs. 1644 crores in 2051.

The graphical representation of the above mentioned three parameter modifications are summarised and presented in Figure 5

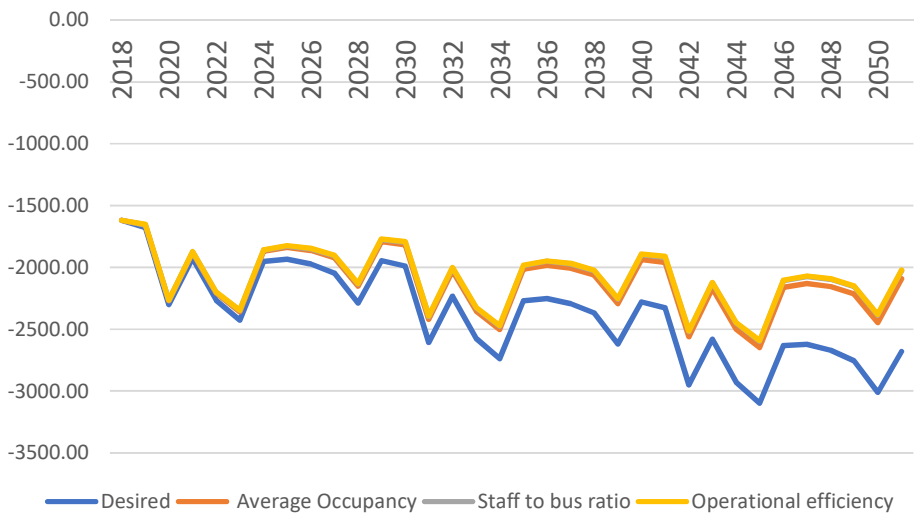

Figure 5: APSRTC probable Profitability Scenario

Profitability scenario quantifies the sensitivity of State support required to operational parameters such as average occupancy, bus to staff ratio and service efficiency. Figure 6 presents the model output in the 'profitability scenario'. The graphs present annual projections (over the next 33 years) of operational profit, revenue, total cost (including investments in infrastructure and fleet), as well break up of state support as total (viability gap), in operational losses and infrastructure and fleet investments. It is demonstrated that in the profitable scenario, operational losses reduce, while

investments in fleet and infrastructure increases, thereby the viability gap requirements (or total financial support requirements from State) remains close to constant.

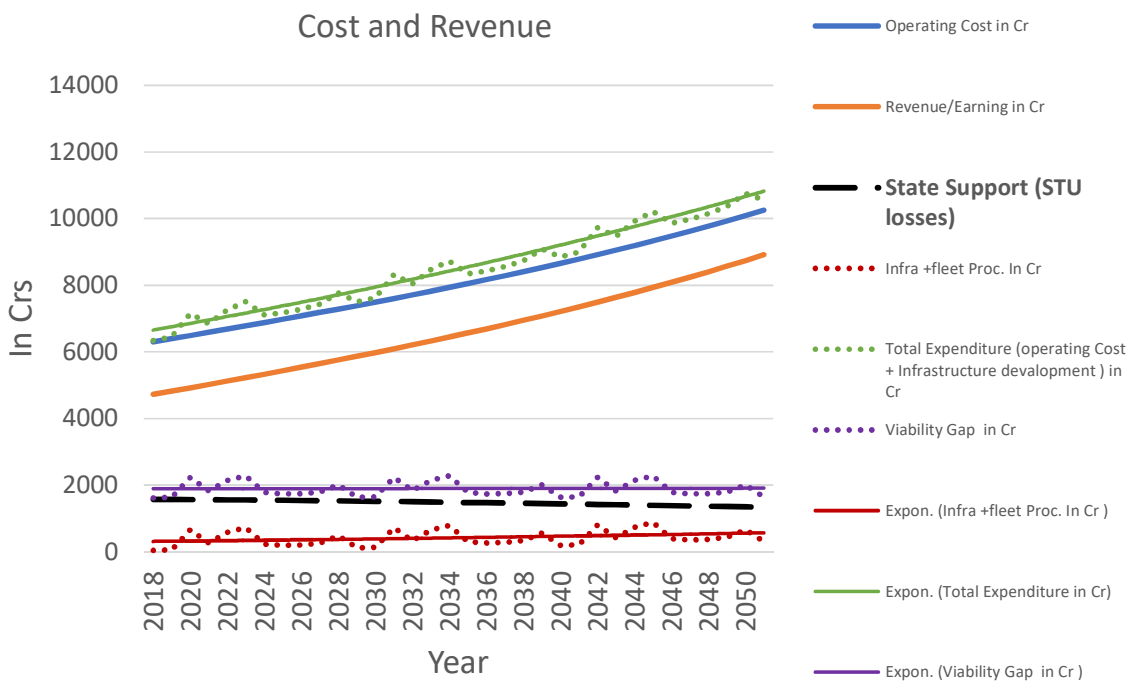

Figure 6: APSRTC operational loss reduction

4.4.2 Profitability Scenario for MSRTC

Current annual State support to MSRTC is estimated at Rs.1527.0 crores in a desired scenario and the outputs generated by the tool projects this to decrease to Rs. 1522.0 crores. Discussed below are the model outcomes for MSRTC, after sequentially tweaking operational parameters on MSRTC scenario 3 ('desired scenario' with 25% mode share)

1. The rate of change of fleet utilization is increased to 0.2% from 0.15% in the model. By doing this, fleet utilization follows an upward trend and achieves the value of 97% by 2051 while it reaches a value of 95% in a desirable scenario. Simultaneously, in this proposed scenario, the losses are reduced from 1522 crores in 2051 in a desirable scenario to 1249 crores. Causing an overall reduction in losses of around 20%.
2. For reducing state support, increase in percentage load factor (Average occupancy) is a good contributing factor though policy, service planning and other interventions will be required to achieve the increased occupancy. Thus, over the changes in fleet utilization, modifications of percentage load factor (Average occupancy) were applied in the model. In line to this the target occupancy was set to 83% with 2.5% rate of change. This led to a gradual increase in

occupancy from 70% to 78% in the horizon year 2051. When combined with the previous step abled MSRTC to reduce its losses to just 192 crores in the horizon year.

3. Over the changes in fleet utilization and percentage load factor modifications in staff to bus ratio were applied in the model. The target bus staff ratio was reduced to 5.2 from 6 in the model. Combined with the previous two changes, the summative effect of these three changes causes MSRTC to achieve a profit of 398 crores in the horizon year.

The graphical representation of the above mentioned three parameter modifications are summarised and presented in Figure 7

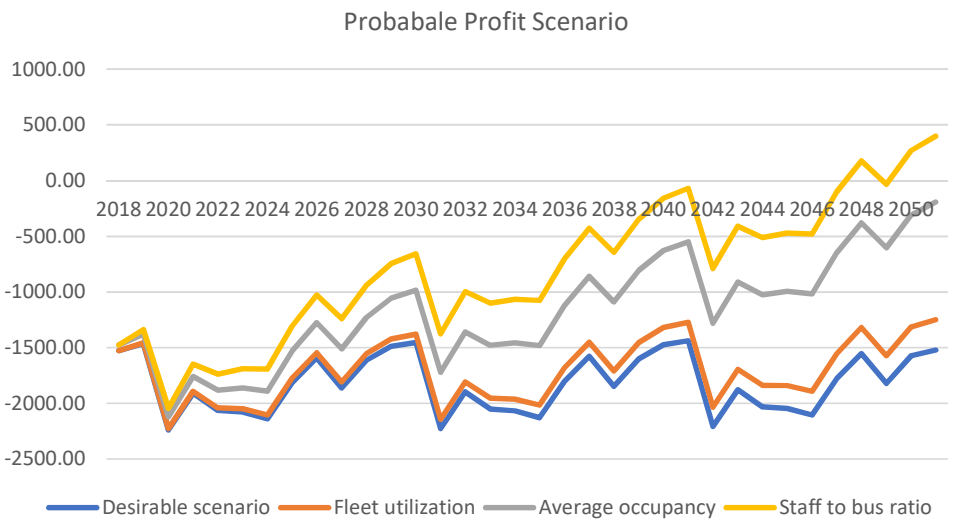

Figure 7: MSRTC Probable profit scenario

After tweaking the profitability factors i.e., fleet utilization, % load factor and staff to bus ratio, it is observed that MSRTC will be able to gain an independent organisation status in future. Figure 8 reveals that in a desirable scenario, MSRTC reaches a negligible state support and becomes self-sustainable based on the current value of money.

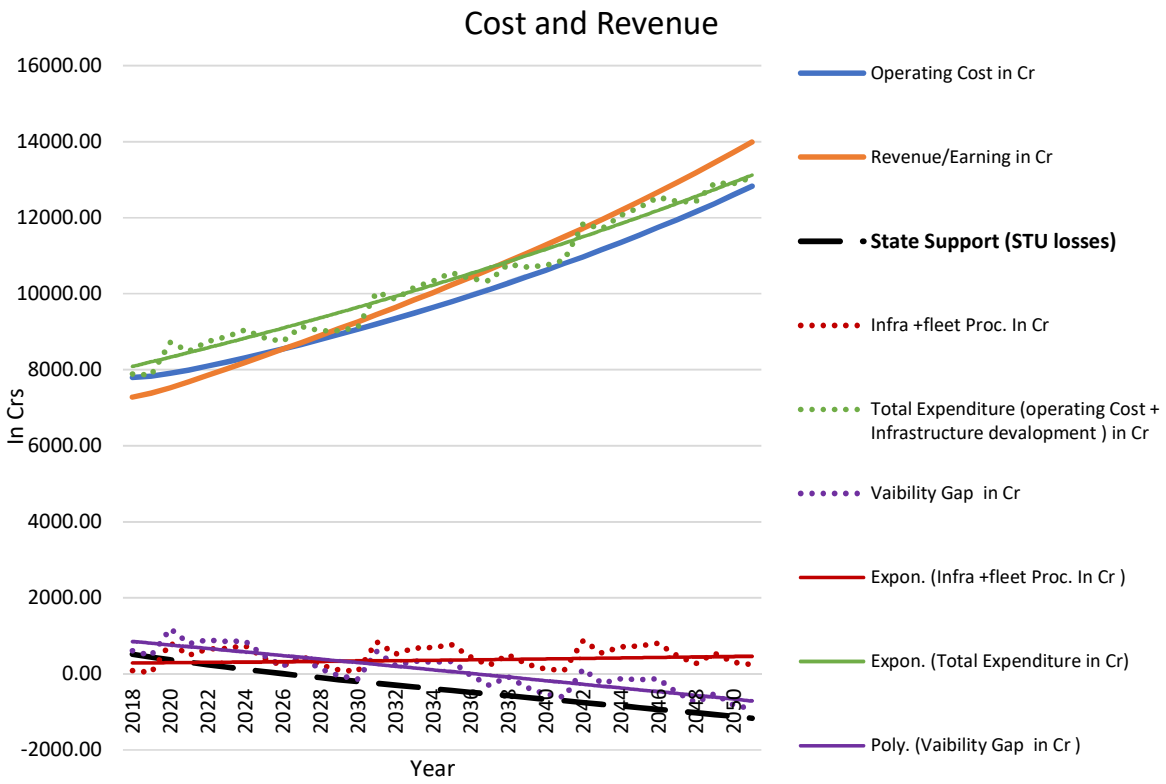

Figure 8: MSRTC Profitability scenario

4.5 Key Findings

The key findings of the model outputs derived for the partner STU's are presented below:

JKSRTC

- Currently, JKSRTC is burdened with ageing fleet and lack of capacity impeding its ability to cater the current demand.
- JKSRTC currently provides fleet and freight services. It operates 373 buses and 255 trucks. The estimated estimated fleet requirement for catering to present passenger demand for the year 2022-23 is 1476 buses.
- It is estimated that in the financial year 17-18, the total financial support requirement for JKSRTC from the state is 40.71crores
- To revive passenger and freight operations, JKSRTC requires a capital infusion (in terms of support from the state) totaling rupees 849 crores over the next six years.
- It is estimated that with additional actions such as improvement in average operational efficiency (from 65% to 97%), average fleet utilization (from 69% to 100%) and average bus to staff ration (from 2.81 to 4.0) JKSRTC will become profitable and self-reliant from 2023-24.

APSRTC

- Existing trends suggests that APSRTC's fleet availability for catering to existing trips will reduce due to reduction of operational efficiency.
- The current mode share of APSRTC is estimated at 20.99%
- Existing trend on the rate of expansion of fleet suggests that the mode share for APSRTC will decline to around 16% in 2051
- APSRTC envisions to increase its mode share to between 25% and 30% by 2051
- The total state support required by APSRTC in 2018 -19 is estimated at Rs.1668.0 crores
- Model outputs suggests improvement in average operational efficiency (from 84% to 90%), average occupancy (from 67% to 80%) and reduction in average bus to staff ratio (from 5.33 to 5.2) can restrict the state support from increasing and keeping it constant near to 1600 crores (up to 2051) even when the fleet size is augmented to cater to achieve the envisioned mode share.

MSRTC

- MSRTC plans to cease all its intracity/urban operations over next six years.
- The current trend of fleet expansion suggests that the intercity operations, rural and mofussil will expand and mode share on these trips will increase from 18.68% today to 21.97 % in 2051.
- MSRTC envisions to achieve a mode share of 25% on intercity trips by 2051.
- Current year annual State support to MSRTC is estimated at 1527.0 crores.
- Model outputs suggests with additional actions such as improvement in average fleet utilization (from 95% to 97%), average occupancy (from 72% to 83%) and reduction in average bus to staff ratio (from 6 to 5.2) will help MSRTC to become profitable and self-reliant from the financial year 2036 -37.

5 Proposed Action Plan for improving the health of the STU's

Profitability scenarios developed for all three partner STU's and literature review has helped identify actions that can lead to a reduction in STU's losses. However, in order to achieve loss reduction effective implementation of these actions is required. To achieve this, the study identified a set of loss reduction strategies and an action plan to implement these strategies. These have been discussed in detail below.

5.1 Loss Reduction Strategies for STUs

Based on review of literature, case studies and best practices the following set of loss reduction strategies for STUs in India have been identified:

1. State Support in terms of Reduced Taxation
2. Reducing Operational Cost
3. Reducing Staff cost
4. Reducing Maintenance Cost
5. Fleet Utilization and Expansion
6. Fleet Upgradation
7. Fare revision
8. Service and Operational plan
9. Land banking
10. PPP Strategies

These strategies are likely to achieve loss reduction by meeting two broad outcomes - improved optimization and improved patronage. Figure 9, presents the formulation of the suggested strategies. Each of the above-mentioned loss reduction strategies are elaborated in the section below:

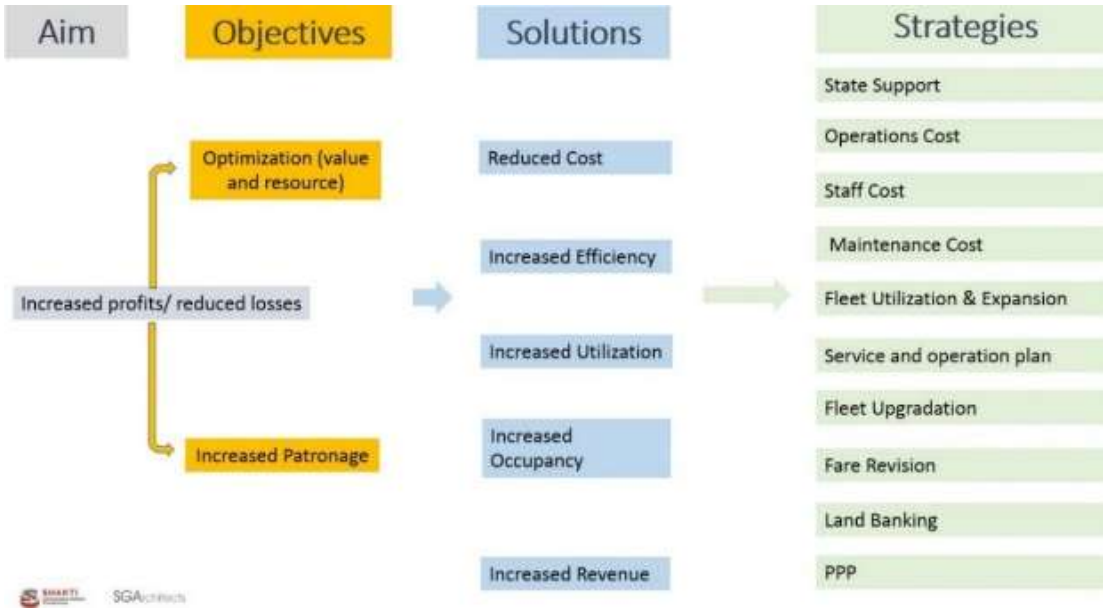

Figure 9: Graphical representation of strategies to achieve loss reduction or profitability for STU's

5.1.1 State Support in terms of Reduced Taxation.

Overall cost breakup for most STUs shows that interest on government loans constitutes the highest share of their expenses, followed by operational and staff costs (Anumita Roychowdhury, 2017). These loans present the balance sheet of the STUs in a bad light. State and City Governments regularly right off these loans, blaming the same on the STU and often labelling them unviable. However, it has been found that a significant factor in the losses of the STUs is the high tax rates that these bodies are subject to. There is no one-size-fits-all answer for road and transport taxes in India as tax rates vary highly by state. The implication of high taxation on STUs can be understood from the case of the Bangalore Metropolitan Transport Corporation (BMTC). In 2014-15, the operator reported a loss of INR 649 million, with a total tax liability of INR 3.096 billion from Motor Vehicle and fuel tax alone. The surplus BMTC would have declared in the absence of these taxes is INR 2.447 billion. Thus, every 1% reduction in these taxes translates to 6.99 extra buses the Corporation could have bought, improving bus frequencies and reducing overcrowding on its peak-hour services (Mukherjee, 2017).
A 2002 World Bank study confirms that, despite being a public transport service - the total tax burden per vehicle km is 2.6 times higher for public transport buses than cars in India. Buses have to pay tax according to the seating formula under the Central Motor Vehicle Act, which is 33 seated plus 20 standing. This is a major disadvantage. Bus agencies pay property tax, excise, customs, road tax, VAT, motor vehicle tax, and advertisement tax, among others. It is suggested that If such tax obligations are reduced and waived off, it will certainly help in improving the overall economic efficiency of the operators (Anumita Roychowdhury, 2017).Taxing public buses at high rates, is in many ways, the low-hanging fruit for a government to increase fiscal revenue. From a commuter's point of view, however, taxes both contribute to higher fares and declining service quality – hardly an incentive to use the service. In the long run, this is likely to make the use of private vehicles more over public transport, resulting in both recurring losses for PT operators and increasing ills such as accidents and congestion, related to use of private modes. In the long-term deteriorating health of public transport companies or STU's results in unavailability of the only affordable means of mobility to millions of people. Thus, it is imperative that to maintain public transport services in the country, high rate of taxes applied in STU's will need to be rationalized. This does not necessarily mean loss of fiscal revenue for the government. Reduction in per bus taxes allows a much-required expansion in the fleet size which substitutes reduced per bus fiscal revenue by increased tax base.

5.1.2 Reducing Operational Cost

The cost to STU for running the bus transport comes as fixed (infrastructure) and variable (operating) costs. Of the two, operating cost are the direct costs involved in the operation of vehicles, such as fuel, spare parts, labor, etc. and should have a direct influence on determining fare structure. Additionally, factors such as traffic volumes, weather conditions, geographical settings, and topographical features, also influences this direct cost. Presently, STU's face an imbalance between operating costs and revenues generated through fare box and non-fare box methods (BUS KARO 2.0 - Case studies from India , 2014). Because, increase in fare has an adverse impact on both patronage and access to mobility, reduction in operational cost may be the only acceptable solution to address this imbalance. Many techniques to reduce the operational cost have been successfully applied by different STU's, which can serve as a source of learning for other STUs.

Fuel cost is one of the most significant components of bus operations. Fuel costs typically accounts for 35% to 50% of total operational cost for operators (Embarq-WRI ,India , 2014). The main reason for improvement in profitability by STU's such as Karnataka road transport corporation (KSRTC), is the vast improvement achieved in fuel efficiency of their buses. For example, the KSRTC's fuel efficiency has increased from 4.70 kilometers per liter of diesel in 1999-2000 to 5.28 km per liter by 2005 (The

Hindu, 2005). But questions remain on methods to choose for improving fuel efficiency. Due to the complexity of variables that impact fuel-efficiency, such as vehicle technology and fuel type, vehicle age, etc., it becomes difficult to set any benchmarks, and prescribe generalized solutions. Findings of the literature review suggests better driver training and offering efficiency improvement linked incentives (to driver) help in promoting fuel efficiency. Better training not only improves the vehicle driving cycle, thereby improving its mileage, it also equips the vehicle crew with mannerism that will contribute to improved passenger comfort. KSRTC employees have been trained to be more courteous to the passengers thereby attracting better patronage, which helped them increase their fare box collection (BUS KARO 2.0 - Case studies from India , 2014). Revenue is a clear measure of passenger acceptance of the service; hence a fixed percentage of the revenue should be shared with drivers and conductors. This reduces the tendency to pilfer and improves efficiency as well customer service. For example, Andhra Pradesh State road Corporation - APSRTC, which was one of the largest operators in the world (before bifurcation of the state) is considered a pioneer for having successfully implemented an incentive scheme for its staff to improve fuel efficiency. The STU pays 4% incentives (2% for the driver and 2% for the conductor) for earnings beyond fare-box benchmark (Andhra Pradesh State Road Transport Corporation 2014) to ensure efficiency of drivers and conductors carry passengers from all designated pick up points. Additionally, cost savings acquired due to improved fuel efficiency can be shared with drivers and the mechanical staff, in pre-determined percentages. An indirect benefit is also expected in the form of discouraging the tendency to make unscheduled stops.

5.1.3 Reducing Staff cost

On an average, staff cost constitutes 40% of STU operational cost. Most STUs have more than 20% overhead (non-operational) staff (cleaners, security, (excess) administrative peons etc.) which add to the cost of operations without revenue improvement. This has resulted in high levels of redundancy with up to seven employees per bus on an average, leading to an increase in per vehicle km operational cost (World Bank , 2005). For some STUs, the high staff cost is due to state government salary and pension norms, which is beyond the control of STU. In many cases it is found, that government norms result in very high staff salaries, without adding much valuation in terms of productivity (Kearney, 2017). For example, senior vehicle crew salaries are very high, and this often has no or little relation to better performance. These inefficiencies also significantly contribute to loss accumulation. Yet other reason for high staff to bus ratio and thus high staff costs can be the deterioration of operational fleet without any correction of the staff required to manage/operate it. In November 2016, Delhi transport Corporation (DTC) had a staff of 28,816 to manage a fleet of 4,128 buses; but since only about 3,537 buses were usually on the road, the staff ratio was close to 6.98. One-third of DTC's total expenditure is on staff salaries. This enormous labor costs skew the balance sheet of these corporations (Anumita Roychowdhury, 2017).

Thus, a significant reduction in operational costs can be achieved by rationalizing the staff remuneration and numbers. Some studies suggest that the scope for reducing per km operational cost is greatest through possible reduction in staff earnings or remuneration (World Bank , 2005). This may not be a practice which is socially accepted or is agreeable by the employee's union, thus innovative improvements may be required in the human resource (HR) policies of the STU's. This can be achieved by comparing the HR policies, and breakup of costs between private and public operators. Some of the means of improving staff utilization without affecting their earning can be through redeployment of excess staff into other more suitable (suited to their experience and payoffs as per government norms) forms of employment, either within or outside the STU. Rationalizing staff deployment gradually reduces the need to hire additional staff for an expanding fleet, till the point of a desire equilibrium. This can be a step towards reducing the bus to staff ratio to recommended 5.2. This will also contribute to gradually optimizing individual staff costs based on value offered to the

organization. Outsourcing of staff for functions like vehicle crew, maintenance, etc., can be another means of reducing undesirably high staff payoffs. However, these measures may also need to be weighed against any potential loss of social and economic well-being of the employees.

5.1.4 Reducing Maintenance Cost

Maintenance and repair are often overlooked as a possible source of savings by STU's. Lack of maintenance not only leads to low vehicle utilization, but reduced attractiveness and reliability, adversely affecting patronage from commuters. Many SRTUs don't effectively implement preventive maintenance strategies. This can be assessed from observed poor correlation of maintenance spend with vehicle productivity (Kearney, 2017). Improving maintenance effectiveness is a potential source for making financial savings. APSRTC is a clear example for this. APSRTC has been able to achieve 99.5% fleet availability by undertaking in-house vehicle maintenance through a vigorous system of checks and monitoring process, which engages multiple levels of management. Whereas in Assam STC, 39% of the fleet is non-operational, largely because of poor maintenance practice (Kearney, 2017). Also, the rate of cancellation of services for BMTC and KSRTC has been reduced from 6.2 per cent to 1 per cent. This is the result of improved maintenance of vehicles and better management of the crew.

Often for cost saving, STU's tend to indulge in to bad maintenance strategies which usually prove to be counterproductive in the long run. Often these strategies include letting buses run to the point of failure, using substandard parts and materials. Thus, it is recommended that the STU should employ staff that have specialized knowledge achieved through constant training. STU should incorporate the use of sophisticated technology that involves detailed analysis of various aspects of the Vehicles. This shall help in detecting any possible flaw or inconsistency with regular patterns with an Immediate effect. STUs should also adopt stringent practices for daily inspections, weekly check-ups, monthly minor services, major services every quarter and a comprehensive annual service of the vehicles. Offloading maintenance activities, though outsourcing may also be considered by STUs. Considerations for this option (for part or complete maintenance activity) may be based on a detailed cost benefit analysis. A good service provider with right expertise/experience, may be able to trouble shoot problems early on, or provide more effective preventative measures, at a lower cost. The reduced cost and high expertise can be achieved by the outsourced organization through improved utilization of the workshop infrastructure and staff. This is generally achieved by servicing buses from different operators in multiple shifts. STUs may be limited by their organizational policies in exploring such innovative optimization techniques - which may only be achieved through outsourcing.

5.1.5 Fleet Utilization and Expansion

The fleet strength, its substance and growth indicate how fast an organization is growing. This is an indicator of its efficiency. Maintenance or growth in share of passenger trips carried by a STU is only possible only through availability of adequate fleet strength. Increasing fleet strength requirements can be met through purchase of additional buses and by increasing the availability of existing fleet by increasing utilization. Fleet utilization indicates the share of revenue earning vehicles out of the total fleet. It reflects the efficiency of the maintenance department of the STU. The higher the figure of fleet utilization, the more efficient is the undertaking. This utilization is subject to the provision of adequate spares to meet foreseen contingencies (periodical maintenance) and unforeseen contingencies (vehicles breakdowns) etc.

The impact of limited fleet growth is reflected in the form of a falling trend of passengers carried and STU mode share - indicating that STUs have not been able to match the growth requirement of the public bus transportation system. Thus, in order to ensure patronage, it is essential for any STU to expand its fleet based on the current and expected demand. An expanding fleet not only ensures that potential passenger trips are captured, but it also attracts more trips by effectively increasing

accessibility and reducing wait time. BMTC, one of the profitable STU doubled its ridership from 2.5 million to 5 million passengers, with a fleet expansion from 3,500 to 6,500 in the last decade. The fleet expansion was based on a long-term strategy and vision with a planning horizon of around 10 years helped the agency to predict the transport requirements in conjunction with the expansion of the city and expected increase in passenger trips.

5.1.6 Fleet Upgradation

Catering to the increasing transportation demand by only fleet expansion, in the absence of increased utilization, leads to increased inefficiencies and losses. Majority of the STU's are unable to sustain a planned growth due to mounting financial losses, largely caused by the continued use of over age bus fleet. Fleet utilization depends mainly on the availability of vehicles fit for traffic. This is because, even if fleet utilization is very high with an old fleet, vehicle utilization and occupancy ratio remain poor, leading to loss of revenue (Kearney, 2017). Older fleet has a poor utilization levels due to longer downtime required for maintenance activities. Moreover, it impacts vehicle productivity as older buses have higher breakdowns. Today, with income levels going up among many categories of passengers, there is a demand for improved services (even at a higher price). This is where private players have been able to capture a greater share from STUs, contributing to their losses. This signifies that STU's need fleet expansion with an upgraded fleet to sustain and face the competitiveness induced by the private agencies. This is the reason why KSRTC introduced more than 100 air-conditioned buses during the past year for long-distance travelers. In the case of BMTC, there is already a plan to introduce air-conditioned Volvo services on selected routes in Bangalore. These progressive corporations are also adopting new technologies to make their operations more efficient and remunerative (Embarq-WRI ,India , 2014).

5.1.7 Fare revision

There is a need for STU's to adopt a scientific approach to determine the fare structure by considering operational costs such as changes in fuel cost and inflation rates. This can be an effective way to maintain service quality and financial sustainability of the operator (Embarq-WRI ,India , 2014). For example - BMTC operates all public bus services in the city of Bangalore, and fares are based on a stage system, with a telescopic structure (BMTC 2014). In other words, fares increase as distances increase, with the cost per marginal unit of distance decreasing as the trip length increases. Each stage is approximately equal to 2 km, although they can be shorter on particular routes. BMTC operates several differentiated services, each with its own fare structure. The historical changes in BMTC fare rates (price per km) indicates that the price per km travelled of bus transport in Bangalore increased by about 75 percent in the past decade. During that period, BMTC fares changed 11 times, roughly once a year on average. With respect to fare setting, BMTC services may be categorized as follows: ordinary services (roughly 85 percent of all services) and other differentiated services (15 percent of all services). In both cases, BMTC utilizes a formula to determine the fare hike (per passenger km) to neutralize the burden of diesel price rise, and dearness allowance (DA) hike for STU employees. In other words, the formula is dependent on two factors, fuel prices and staff costs. BMTC conducts a review twice a year to determine whether a change in the fare structure is necessary. It is expected that as a public service STUs will need to maintain their fare to ensure affordability and access by general public. This is why, BMTC fare revision for ordinary services, state government approval is required. However, fare revision for other value added and premium services, has higher acceptance and often proves to be profitable. This can be used to cross subsidize any operational losses (caused by delay in fare revision) of ordinary services.

5.1.8 Service and Operational plan

With the expansion of bus transport services, there is an increasingly strong need to allocate/plan space for bus infrastructure such as depots and terminals. Strategic distribution of infrastructure spaces across the city, region or State, can significantly improve STU efficiency (Kearney, 2017). The service and operations based on a planned distribution and arrangement of the infrastructural assets of STU's will lead to improved efficiency and cost saving resulting in overall loss reduction. For example - to reduce dead mileage, Delhi Transport Corporation (DTC) has initiated the practice of re-fueling buses at depots closest to the terminating point and not necessarily at the mother depot (Bhasin 2011). Such efforts require a re-look at the operational and service plans. Software solutions for asset management, can be useful here. Additionally, they can help improve service consistency by predicting future demand, use data analytics to inform real time asset deployment and service plan modifications, monitor asset management and maintenance and highlight issues, etc. (World Bank , 2005). On similar lines, 38 depots and 50 bus terminals for BMTC were developed through a long-term land banking strategy (Bangalore Metropolitan Transport Corporation 2014). This aspect has been discussed in detail below.

5.1.9 Land banking

Normally, public transport corporations earn revenue from the sale of tickets and passenger passes which is known as traffic revenue (Anumita Roychowdhury, 2017). There is a revenue source other than traffic revenue which is known as the commercial revenue. Generation of this commercial revenue can certainly help STU's to minimize their recurring loss. In the recent times it has been realized by the STU's that the civil infrastructure and land holding with these agencies can be utilized in generating sustainable of commercial revenue. This can be achieved mainly by letting out the building space available with the public transport corporations. Not only this, the STU's also need to revamp its existing assets – terminals, depots and workshops instigated through better planning (Mukherjee, 2017). The current approach to plan bus infrastructure such as depot and terminal, has been focusing on fulfilling basic requirements such as docking bays for buses in terminals and parking space in depots. Most bus infrastructure are not planned for functional and space use efficiencies.

Better planning of Bus infrastructure, such as depots and terminals, has an important contribution in overall increase in patronage (due to improved passenger experience at the terminal) and improved vehicle utilization (due to improved maintenance facilities). Better planning also allows better utilization of space, allowing accommodation of more buses and/or passengers or releasing space for potential monetization.

For example, the Bangalore Development Control Regulations (Revised Master Plan 2015 - Bangalore Volume III 2007) specify transportation zones, which consider bus stands, bus shelters, and transport depots, etc. This gave birth to the innovative concept of Traffic and Transit Management Centers (TTMCs). Traffic Transit Management Centers are huge empty areas with a cumulative site area of 1,43,248 m^2 and parking for 2800 two wheelers and 3715 four wheelers. The space allowed people to park their two-wheelers and four-wheelers and switch to public transport for commuting. Apart from facilitating increased patronage from commuters, TTMCs have been a significant source of revenue to BMTC. The total expected revenue from these sites is more than 48 crore per annum. Thus, these centers helped BMTC compensate part of their losses. Using this concept, BMTC has decided to identify and leverage its land holdings in strategic locations throughout the city. This concept combines the development of passenger terminals, with the creation of commercial real estate space. This enabled BMTC to utilize rental revenue to cross-subsidize the construction and operational cost of the terminal and similar amenities (Embarq-WRI ,India , 2014). This particular model from Bangalore provides an example of how to leverage land holdings to solve the need to provide infrastructure for bus services

and the need to generate non-fare box revenue. Innovative contracting options such as through the PPP mechanism can increase the viability of such projects.

5.1.10 Other PPP Strategies

Public private partnership (PPP) strategies can be used by STUs, to counter the competitive edge of private operators. For example, under the PPP model implemented by Assam State Transport Corporation (ASTC), private vehicle owners operate their vehicles under the ASTC brand. ASTC undertakes vehicle management including scheduling as well as dispatching, and allow vehicle owners to utilize its stations, where they are also provided support for ticket issuance. ASTC receives 10 percent of the gross income as commission, and 90 percent belongs to the owner. The program was initiated with 559 buses in 2001-02 and grew to 1,790 buses in 2005-06. During this period, the annual earnings increased from INR 2 crore to INR 14 crore (Embarq-WRI ,India , 2014). While this approach enabled ASTC to increase its revenue, it also helped in improving operational efficiency. A number of ASTC properties, like their depots, terminals, interchanges, etc. are at prime locations. ASTC management has decided to commercially utilize them through re-development by integrating multi-level parking lots, cinemas, shops, hotels, petrol pumps, etc., at these locations. These initiatives have helped the agency to open an alternative revenue stream for cross-subsidizing operational and non-operation al costs. These efforts have allowed ASRTC to reduce their annual losses to Rs. 1.35 crore. ASTC has also explored additional methods to diversify from its core business of bus operations, with the intention to cross-subsidize any losses, and to achieve overall profitability (Embarq-WRI ,India , 2014). These included providing courier services, commercial operation of tire re-treading plants and a printing press.

5.2 Action Plan

For one or more of the above-mentioned strategies to be executed a planned approach from STU's, to seek alternate sources of revenue generation, for maintaining profitability and financial sustainability, is required. Review of literature reveals, that multiple STU's have successfully achieved, or demonstrate a clear potential for achieving loss reduction if the selected strategies, interventions and/or actions are initiated, through an integrated long-term action plan. This action plan has three main components – planning, funding and implementation(Figure 10).

Figure 10: Components of Action Plan

The details of each of these components has been presented below.

5.2.1 Planning

The first step towards achieving and sustaining profitability for MSRTC, is planning of different strategies critical in achieving this objective. This planning phase also includes proposing budgetary

requirements and action plan for implementation (of each). The studies to undertake this planning may be conducted in house or through a qualified consultant/expert. These studies (which may also need to be cross referenced with each other) shall include the following:

1. **Long range demand assessment and service planning –** STUs stand to benefit from long range, division and service specific planning for operations in both current and future scenario. Such long-range plans should have annual projections for the next 30 to 50 years. These plans can be developed through a mixed use of existing tools, or custom defined approaches. The key objectives to be achieved by such plans are as following:
    a. The plans shall be responsive to or build in parameters to account for expected changes in demography, infrastructure expansion (such as road network improvement), and other scenarios.
    b. The plans shall project service, division, origin-destination and trip length specific projection of demand in different scenarios. These scenarios shall be based on fare and developmental factors, apart from other parameters.
    c. Based on the demand estimates, the study should recommend (today and in future) potential routes (or origin-destinations to be served), estimate of fleet requirement for different services (such as AC, standard, luxury).
    d. This plan should also recommend for each division and depot/terminal in each division the required capacity for catering to traffic over the next 20 to 50-year period. Based on this it should be able to identify additional land requirement, or excess land available for other uses (for a defined time period), at each depot and terminal site. This may include recommendation of new sites or shifting of existing sites with an aim to improve accessibility by passengers and improve operational efficiency (including reduction of dead miles).
    e. The plan shall recommend a desirable fare structure (for different services) from the passenger paying capacity, desire to pay and service valuation perspective. This shall be provided on annual basis for the study period (30 to 50 years).
    f. The division and service wise study findings shall conform to the aggregated MSRTC and/or State level projections. The aggregated findings shall be used to recommend revisions in current taxes on MSRTC. The study shall establish recommendations on tax rates in line with profit-loss estimates for the corporation in all defined scenarios (also accounting for potential technological and planning interventions to improve profitability), on an annual basis, over the study period (30 to 50 years). The recommendations shall be based on this understanding highlighting the optimal tax levels required for improving financial health of the Corporation without significantly denting the tax revenue earned by the state (possibly due to expansion of tax base).
    g. The plan shall define annual budgetary requirements for both fixed and variable costs, in all defined scenarios. This budgetary requirement shall be both division wise and aggregated for the Corporation, based on the estimated fleet and infrastructure development, maintenance and operational requirements (in all defined scenario over the study time period).
    h. The long-range plan shall define annual achievable benefits in terms of profitability, optimization, increased patronage, etc. It shall also include an economic analysis of these identified benefits, along with a detailed cost benefit analysis (accounting for the budgetary requirements to achieve the benefits).

i. The plan shall detail a road map for rolling out the recommendations on suggested interventions in a phased manner, taking in to account the practical implementation issues, budgetary limits, etc.

2. **Digitization and IT Integration Plan –** To achieve a sustained optimization, high level of automation and digitization is required in fleet, operations and service management. This is especially true for large STUs such as MSRTC. To achieve this, planning and scoping for digitization is required to be undertaken. This can be achieved by developing a detailed, digitization and IT integration plan, with the following components:
    a. Audit the current level of digitization achieved and generate a gap assessment based on future level of digitization and IT integration required. Using this, establish the scope of digitization and IT integration based on paper less and key board verses benefit optimization approach.
    b. The digitization and IT integration scope shall include but may not be limited to fleet management, scheduling and planning as well bus and driver performance monitoring cum evaluation.
    c. The scope shall detail the following abilities of one or multiple equipment, software to be procured or developed:
        i. Automation in depot management (and MIS) including information gathering, assimilation, analysis and sharing of fleet, staff, spare parts, fuel, maintenance scheduling, etc. related information
        ii. The ability of the software or tools to identify and raise specific maintenance requirement for fleet, identify issues, etc. (based on defined benchmarks) based on the input data through digitization od depot management and MIS.
        iii. Automation and digitization for gathering, assimilation, analysis and sharing of real time bus location, bus performance and ticketing data.
        iv. Realtime bus scheduling based on real time bus location data, demand parameters (also gathered from real time ticketing data) and other predefined temporal and spatial factors.
        v. Integration of GPS and ITMS software to capture real time bus and crew performance data. This data shall need to be analyzed to evaluate (and highlight shortcomings as part of the software dashboard) crew and bus performance against defined benchmarks.
    d. The plan shall include detailed road map, action plan and budgetary requirement for development, procurement and deployment of identified digitization, automation and IT tools. It shall estimate and detail the level optimization expected to be achieved through the defined interventions, based on expected increase in staff utilization, vehicle utilization, fleet utilization, operational efficiency, occupancy, etc. It shall also provide an assessment on the expected positive impact on patronage, and the impact on expected additional trips attracted. Through these details the plan shall detail a cost benefit analysis for the investments proposed for the defined interventions.
    e. The plan shall include a list of software, equipment or tools required to be inducted in the organization as a part of this plan, along with recommendation for off-the shelf or development approach for the same. Where development is recommended it shall explore the possibility of integrating royalty model with the software developers, if and when the developed software is licensed to other STUs/operators. This recommendation shall be based on a detailed cost benefit analysis.
3. **Staff Training Plan –** A review of case studies and other literature, suggests that training of staff especially crew, plays a critical role in achieving significant reduction in operational and/or other

costs. This training is not limited to induction training but should include regular training which aims to refresh the abilities of the crew as per prevailing requirements and technological as well operational developments. This implies that recurring annual training programs with fixed targets will need to be built in to the administrative structuring and annual organizational budget. This study shall detail these requirements as following:

a. It shall identify the gaps in skill levels of different staff categories and identify optimization and patronage improvement parameters that will be positively affected by addressing these gaps.
b. It shall identify the training programs and define the staff strength or percentage of staff strength (for different categories of staff) that need to be provided these identified training. It shall also identify the frequency of these training programs for each staff category. Some of the training programs that may be included are as following:
    i. Driver training to improve fuel efficiency. Such training is conducted by the Government of India undertaking – Petroleum Conservation Research Authority (PCRA).
    ii. Skill development programs, such as those conducted under national skill development mission.
    iii. Trainings to improve mannerism for staff which have a passenger interface (such as bus crew).
    iv. Specialized equipment training for workshop staff. This may be conducted with bus or equipment manufacturers.
    v. Specialized equipment and software training for other staff, such as planning, traffic and statistical department.
    vi. Specialized leadership training for senior management and administrative staff.
    vii. Generalized safety and other training for all staff.
c. It shall highlight how the proposed training plan shall improve staff productivity and operational efficiency, apart from improving the skill levels and general employability of the staff. It shall also detail the contribution of the proposed training in optimizing existing staff utilization, through re-assignment of excess staff or of overhead staff (in a phased manner over the study period).
d. The plan shall define a road map to roll out this training plan along with the fixed and variable budgetary requirements.
e. The study shall include an economic analysis of the expected benefits of the proposed interventions as listed in the training program. It shall also evaluate these benefits against the expected expenditure (over the study time period, i.e. 30 to 50 years) through a detailed cost benefit analysis.

4. **HR Policy and Administrative Restructuring Plan –** It is understood that current the administrative structure of most STUs and their HR policies, are old and may need revision/re-writing to better cater to new understandings, technological advances, policy changes etc. Additionally, the proposed digitization and training plans are also likely to raise requirements for changes in the current HR policies and administrative structure. These changes are likely to contribute to improving the organizational efficiency, potentially resulting in reduced costs and improved revenues. In order to achieve this, an HR policy and administrative restructuring plan is proposed to be developed. The key features and objectives to be achieved by this plan may include the following:

a. Evaluate current HR practices and administrative structure against the current and projected (over the study period, i.e. 30 to 50 years) organizational requirements (division and department wise). This should also take in to considerations best practices from other operators (both private and public) and organizations.
b. Propose a revised administrative structure and HR policies based on the gap assessment. These shall incorporate the following:
    i. Build in incentivization mechanism in HR policies, especially for staff whose performance have a direct impact on the profitability of the organization. These include the crew and the maintenance staff.
    ii. Build in/revise/review staff category specific increment/promotion norms.
    iii. Incorporate measures, norms, administrative structures, to allow re-assignment, or re-habilitation of excess staff (also for overhead staff where required).
    iv. Identify divisions departments that may be merged, and or new divisions departments that may need to be formed. Propose the revised administrative and management structure in line with these changes.
    v. Identify and propose, functions, responsibilities, etc. which may be outsourced
c. The study shall quantify the economic and other benefits to the organization (over the study period), that may be achieved by undertaking the interventions proposed in the plan. It shall also highlight any expected adverse and/or positive impact on the well-being of the staff (social, moral or economic) as a result of the proposed changes.
d. The study shall estimate the budgetary requirements for undertaking the proposed administrative and HR policy changes. Such a budgetary requirement shall account for any loss of revenue (or other losses) due to disruptions in administrative and HR processes expected as a result of this transition.
e. The study shall include cost benefit analysis that may be used to justify the proposed interventions (listed in the plan) over short and long term.
f. The study shall also propose a detailed action plan and time line for rolling out the recommendations included in the plan.

5. **Business Plan –** Based on the four plans listed above, a detailed business plan for MSRTC can be developed. This plan shall be based on the budgetary, economic and action plan details included in each of the plan, resulting in an overall organizational business plan which shows a clear economic and financial viability of the business. The plan shall highlight the investment requirement and the expected profit loss estimates over a long term – 30 to 50 years. This plan shall be used to seek investments from Government or private entities and/or raise short- or long-term loans from financial institutions. The salient features/inclusions and objectives of this business plan shall be as following:
    a. The plan shall include the current worth of the organization, highlighting fixed and movable assets, past and current expansion and growth, staff strength, expertise, business (service) highlights, etc.
    b. The plan shall detail expected and future market share, current and future plans for growth, current and future plans for operational and service improvement, etc. It should clearly highlight growth trends of cost, revenue and expected revenue showing expected break-even point (year), in different scenarios.
    c. It shall highlight potential fare box and non-fare box revenue sources to be tapped (or planned to be tapped). This shall include details of identified land parcels for potential

land banking. These details shall be accompanied with the expected valuation of the same.

d. The plan shall also include any identified potential of private partnerships in different aspects of the STU functioning such as depot operations, fleet operations, etc.
e. It shall identify all potential threats and opportunities such as taxation norms and government policies.

5.2.2 Funding and Financing

The business plan should form the basis of the funding approach for investment requirements, estimated as a part of the planning process. The business plan shall be used to generate confidence in the current or potential financial health of the organization, which shall be useful to seek investments from one or more sources. These may include the following:

- Government funding through state budgetary support, which is also the current route
- Private investments through different public private partnership (PPP) arrangements
- Short- and long-term loans from financial institutions such as national banks, Asian Development Bank (ADB), World Bank, etc.

The funding shall be sought in line with an integrated road map for implementation.

5.2.3 Implementation

After the planning stage and after financing/funding for identified interventions is in place implementation phase begins. This stage begins with identification critical landmarks or milestones in the implementation process. This may be referred to as the pre-implementation stage. At this stage, the Departments/organizations concerned with the implementation of the identified actions should be under an obligation and made responsible to adhere to the time line for the achievement of identified milestones.

For this, there are people to recruit, train, and manage. tasks need to be assigned, completed work needs to be signed off, uncompleted work needs to be re-scheduled, and perhaps re-costed. Solutions for developing problems need to be found quickly. This requires professional management of the implementation process. Project management is a topical area of professional application to achieve the planned objectives rapidly and professionally (Hauc and Kovac, 2000). Professional management of the implementation process should help MSRTC to frame an approach encompassing the entire organization. Thus, the methodology for implementation of planned action should span across multiple levels and departments. The proposed implementation arrangements should follow established procedures and practices as much as possible to enable speedy and efficient implementation. These include:

1. A dedicated project management unit (PMU) should be established in the executing agency, consisting of managerial staff (from different departments) and technical experts assisted by an appointed, professional consultants. These may be project management and transaction advisory consultants amongst others (Project Administration Manual, 2015).

2. To provide strategic direction and oversight, a Project Steering Committee (PSC) should be constituted, with the concerned departments officials such as Human resource, finance, operations administration etc. Each department should also have its Project Coordination

Committee (PCC) headed by the respective supervisors or managers. The PCC should identify, initiate, review and approve subprojects (Project Administration Manual, 2015).

3. A dedicated project implementation unit (PIU) should be established by STU's in the implementing agencies headed by a Project Implementation Director. The PIU should be supported through their secondary implementation units embedded in terminals and depots to supervise and implement the approved activities (Project Administration Manual, 2015).

4. Apart from decentralization of the administrative machinery and provision of adequate coordinating mechanisms at the local level, it will be necessary to ensure that at every stage of planning and implementation there is full participation and involvement of the other stake holders. The selection of the specific tasks, however, is governed by local conditions and in assigning priorities it might be necessary to involve both the administration at the local level as well as the representatives of people particularly of the beneficiary groups. This entails formulation and implementation of a detailed communication strategy. This strategy should help address any doubts about the objectives of the exercise and thus control resistance to the implementation process.

5.2.3.1 Implementation Actions:

The implementation phase involves putting the project plan into action. Thus implementation, should consider development of a precise action plans as an integral process. To achieve the optimum results out of the action plans, the following points regarding the implementation must be taken in to consideration.

1. The comprehensive plan of action is needed to be drawn up after very careful consideration and exhaustive consultations with the State Governments, Central Ministries and various other organizations concerned with the Plan formulation and its implementation strategies (Planning Commission, 2017). This plan shall include identification of projects, tasks and sub tasks (as identified at the planning stage) for implementation in an integrated and a time bound manner.
2. Consultations should also be held with a wide variety of professional organizations as well as individual experts and communication experts and trade union representatives.
3. The spent over schemes/projects etc. which are included prior plans shall be taken in consideration. This will ensure that on-going schemes/projects are completed expeditiously, and the resources earmarked for them are not spread over many other schemes resulting in neither the on-going schemes being productive, nor the new ones progressing satisfactorily due to sub-critical investment.
4. It is essential a firm time-line is drawn up consisting the date on which the project report will be firmed up considering various parameters specified in the plan. This will Include - the dates on which the sanctioning authority, whether it is the State Government, or the Central Government will be ready with the formal sanction. Additionally, the specific dates on which contracts for various schemes falling under the formulation plan is finalized and the contract documents signed.
5. To ensure that the time table as mentioned above is strictly adhered to, the delegation of authority for investment decisions, clearance of contracts etc. should be considerably enhanced, and indeed a good deal of trust be placed on those who are directly responsible for implementing the strategies.

6. Subsequently, a PERT chart should be developed for each strategy, mentioned with deadline. There should be no revision backwards of the deadline, and all performance should be judged against the final targets (Planning Commission, 2017).

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Annexure

1.List of Input Data

S.no	List of Data- Inputs
1	Current Year
	FLEET DETAILS
2	Current Intra City Bus Fleet
3	Current Intra City per bus seating Capacity
4	Current Inter City Bus Fleet
5	Current Inter City per bus seating capacity
	FLEET UTILIZATION AND OPERATIONAL EFFICIENCY
6	Current year fleet utilization (Intra City)
7	Current year fleet utilization (Inter City)
8	Current year operational efficiency (Intra City)
9	Current year operational efficiency (Inter City)
	FLEET AGE
	INTRA CITY FLEET
10	Percent of fleet size with age <=1 year
11	Percent of fleet size with age >1 to 2 years
12	Percent of fleet size with age >2 to 3 years
13	Percent of fleet size with age >3 to 4 years
14	Percent of fleet size with age >4 to 5 years
15	Percent of fleet size with age >5 to 6 years
16	Percent of fleet size with age >6 to 7 years
17	Percent of fleet size with age >7 to 8 years
18	Percent of fleet size with age >8 years
	INTER CITY FLEET
19	Percent of fleet size with age <=1 year
20	Percent of fleet size with age >1 to 2 years
21	Percent of fleet size with age >2 to 3 years
22	Percent of fleet size with age >3 to 4 years
23	Percent of fleet size with age >4 to 5 years
24	Percent of fleet size with age >5 to 6 years
25	Percent of fleet size with age >6 to 7 years
26	Percent of fleet size with age >7 to 8 years
27	Percent of fleet size with age >8 years
	TRIP AND CITY PROFILE DATA (CENSUS AND OTHER REPORTS)
28	Data Year
29	Total urban population
30	Total rural population
	NO. OF TRIPS (TOTAL DAILY WORK TRIPS)

31	Total daily intra city trips from urban area (<=10km)
32	Total daily intra city trips from urban areas (>10km)
33	Total daily intercity trips from rural areas (<10km)
34	Total daily intercity trips from rural areas (>=10km)
	NO. OF TRIPS (TOTAL EDUCATION TRIPS)
35	Total daily intra city trips from urban area
36	Total daily intercity trips from rural areas
	NO. OF BUS TRIPS (TOTAL DAILY NON-WORK TRIPS) Intra + Inter city
37	Daily same day trips
38	Daily overnight trips
39	Daily Foreign trips
	NO. OF IPT TRIPS (TOTAL DAILY NON-WORK TRIPS) Intra + Inter city
40	Daily same day trips
41	Daily overnight trips
42	Daily trips by foreign visitors
	AVERAGE TRIP LENGTH
43	Average pass. trip length of intra city trips
44	Average pass. trip length on intercity trips
	INTRA CITY TRIPS (MODE SHARE) Work Trips
45	Mode share of IPT trips (trip length <=10km)
46	Mode share of Bus trips (trip length <=10km)
47	Mode share of IPT trips (trip length >10km)
48	Mode share of Bus trips (trip length >10km)
	INTER CITY TRIPS (MODE SHARE)
49	Mode share of IPT trips (trip length <=10km)
50	Mode share of Bus trips (trip length <=10km)
51	Mode share of IPT trips (trip length >10km)
52	Mode share of Bus trips (trip length >10km)
	NATURE OF tourist TRIPS
53	Tourist trips as percent of non-work same day trips
54	Tourist trips as percent of non-work overnight trips
55	Tourist trips as percent of non-work Foreign trips
56	Percent of intercity trips >10km originating from urban area
	STU DATA
57	Data Year
58	No. of daily intra city STU pass. trips
59	No. of daily intercity STU pass. trips
60	Total number of intra city routes operated daily
61	Average route length of intra city routes (km)
62	Total number of (bus) trips (one way) on intra city routes per day
63	Total number of inter-city routes operated daily
64	Average route length of intercity routes (km)

65	Total number of (bus) trips (one way) on intercity routes per day
66	Intra city average occupancy (% of seating capacity)
67	Intercity average occupancy (% of seating capacity)
	GROWTH RATES
68	Average annual urban population growth rate
69	Average annual rural population growth rate
70	Expected average tourism growth rate over next 30 years
	BUS STAFF RATIO
71	Current Intra City average staff per bus for the STU
72	Current Inter City average staff per bus for the STU
	COST AND EARNING
73	Earning per km Intracity
74	Earnings per Pass (Intra City)
75	Ticket price per km (Intra City)
76	Average trip length per pass. (Intra City)
77	Operating cost per km (Intra city)
78	Earning per km Inter city
79	Earnings per Pass (Inter City)
80	Ticket price per km (Inter City)
81	Average trip length per pass. (Inter City)
82	Cost per km (Intercity)

2.List of Default values

S.no	List of Defaults
1	Expected annual improvement in fleet utilization (if current <90%) - Intra City
2	Expected annual improvement in fleet utilization (if current <99%) - Intra City
3	Expected annual improvement in fleet utilization (if current >=99%) - Intra City
4	Expected annual improvement in fleet utilization (if current <90%) - Inter City
5	Expected annual improvement in fleet utilization (if current <99%) - Inter City
6	Expected annual improvement in fleet utilization (if current >=99%) - Inter City
7	Annual expected improvement in operational efficiency 'GAP' (other than fleet utilization) - Intra City
8	Annual expected improvement in operational efficiency 'GAP' (other than fleet utilization) - Inter City
9	Average annual increase in income levels
10	Average expected life of a Type 1 - Intra City Bus
11	Average expected life of a Type 2 - Intra City Bus
12	Average expected life of a Type 3 - Intra City Bus
13	Average expected life of a Type 1 - Inter City Bus
14	Average expected life of a Type 2 - Inter City Bus
15	Average expected life of a Type 3 - Inter City Bus
16	Achievable target mode share (Intra City Trips) - IPT for less than 10km trip length

17	Achievable target mode share (Intra City Trips) - STU Bus for less than 10km trip length
18	Achievable target mode share (Intra City Trips) - Other Bus for less than 10km trip length
19	Achievable target mode share (Intra City Trips) - IPT for more than 10km trip length
20	Achievable target mode share (Intra City Trips) - STU Bus for More than 10km trip length
21	Achievable target mode share (Intra City Trips) - Other Bus for More than 10km trip length
22	Achievable target mode share (Inter City Trips) - IPT for less than 10km trip length
23	Achievable target mode share (Inter City Trips) - STU Bus for less than 10km trip length
24	Achievable target mode share (Inter City Trips) - Other Bus for less than 10km trip length
25	Achievable target mode share (Inter City Trips) - IPT for More than 10km trip length
26	Achievable target mode share (Inter City Trips) - STU Bus for More than 10km trip length
27	Achievable target mode share (Inter City Trips) - Other Bus for More than 10km trip length
28	Annual rate of Change (Intra City Trips) - IPT for less than 10km trip length
29	Annual rate of change (Intra City Trips) - STU Bus for less than 10km trip length
30	Annual rate of change (Intra City Trips) - OTHER Bus for less than 10km trip length
31	Annual Rate of change (Intra City Trips) - IPT for more than 10km trip length
32	Annual rate of change (Intra City Trips) - STU Bus for More than 10km trip length
33	Annual rate of change (Intra City Trips) - OTHER Bus for More than 10km trip length
34	Annual rate of change (Inter City Trips) - IPT for less than 10km trip length
35	Annual rate of change (Inter City Trips) - STU Bus for less than 10km trip length
36	Annual rate of change (Inter City Trips) - OTHER Bus for less than 10km trip length
37	Annual rate of change (Inter City Trips) - IPT for More than 10km trip length
38	Annual rate of change (Inter City Trips) - STU Bus for More than 10km trip length
39	Annual rate of change (Inter City Trips) - OTHER Bus for More than 10km trip length
40	Percent of same day non work trips from within state
41	Percent of overnight non work trips from within state
42	Percent of same day non work trips less than 10km
43	Percent of overnight non work trips from within state
44	Percent of overnight non work trips less than 10km
45	Percent of same day non work trips by city bus
46	Percent of same day non work trips by intercity bus
47	Percent of overnight non work trips by city bus
48	Percent of overnight non work trips by intercity bus
49	Percent non-work trips that are intra-city
50	Intra city non work trips <10km by bus
51	Intra city non work trips >10km by bus
52	Intercity non work trips <10km by bus
53	Intercity non work trips >10km by bus
54	Intra city non work trips <10km by IPT
55	Intra city non work trips >10km by IPT
56	Intercity non work trips <10km by IPT
57	Intercity non work trips >10km by IPT
58	Percent of STU Intra city trips <10km as percent of total intra city non work trips by bus

59	Percent of STU Intra city trips >10km as percent of total intra city non work trips by bus
60	Percent of STU Intercity trips <10km as percent of total intercity non work trips by bus
61	Percent of STU Intercity trips >10km as percent of total intercity non work trips by bus
62	Percent of same day education trips less than 10km in urban areas
63	Percent of same day education trips less than 10km by public buses in urban areas
64	Percent of same day education trips less than 10km by IPT in urban areas
65	Percent of same day education trips more than 10km by public buses in urban areas
66	Percent of same day education trips more than 10km by IPT in urban areas
67	Percent of same day education trips less than 10km in rural areas
68	Percent of same day education trips less than 10km by public buses in rural areas
69	Percent of same day education trips less than 10km by IPT in rural areas
70	Percent of same day education trips more than 10km by public buses in rural areas
71	Percent of same day education trips more than 10km by IPT in rural areas
72	Non-Work bus trips origin from State (travelling outside state) as percent of non-work bus trips in state
73	Non-work IPT trips origin from State (travelling outside state) as percent of Non-work IPT trips in state
74	Work bus trips origin from other states (travelling to state) as percent of work bus trips in state
75	Work IPT trips origin from outside state (travelling to state) as percent of work IPT trips in state
76	Desired/Target Average occupancy as percent of average seating capacity (Intra City buses)
77	Desired/Target Average occupancy as percent of average seating capacity (Inter City buses)
78	Ultimate achievable intra city trip length
79	Expected annual percent change in Intra city trip length
80	Ultimate achievable average intercity trip length
81	Expected annual percent change in intercity trip length
82	Ultimate achievable average number of intra city trips per bus per day
83	Expected change in average number of intra city trips per bus per day
84	Ultimate achievable average number of intercity trips per bus per day
85	Expected change in average number of intercity trips per bus per day
86	Expected maximum average route length for Intra city trips
87	Expected annual change in average intra city route length
88	Expected maximum average intercity route length
89	Expected annual change in average intercity route length
90	Average Cost of Intra City Bus Type 1
91	Average Cost of Intra City Bus Type 2
92	Average Cost of Intra City Bus Type 3
93	Average Cost of Inter City Bus Type 1
94	Average Cost of Inter City Bus Type 2
95	Average Cost of Inter City Bus Type 3
96	Average expected revenue from scrapping of Intra City Mini Bus
97	Average expected revenue from scrapping of Intra City Regular Bus

98	Average expected revenue from scrapping of Intra City Luxury Coach
99	Average expected revenue from scrapping of Inter City Mini Bus
100	Average expected revenue from scrapping of Inter City Regular Bus
101	Average expected revenue from scrapping of Inter City Luxury Coach
102	Land Required per bus for intra city depot development
103	Land Required per bus for intercity depot development
104	Land Required per bus for intra city terminal development
105	Land Required per bus for intercity terminal development
106	Cost per bus for developing intra city depot
107	Cost per bus for developing Intercity depot
108	Cost per bus for developing intra city terminal
109	Cost per bus for developing Inter City Terminal
110	Average intra city depot capacity
111	Average Inter City Depot Capacity
112	Average Intra city terminal capacity
113	Average Intercity terminal capacity
114	Factor to relate Intra city terminal capacity to bus fleet (Fleet/(Capacity*X), where X=)
115	Factor to relate Intercity terminal capacity to bus fleet (Fleet/(Capacity*X), where X=)
116	% of non-local STU buses using intercity terminal (as % of STU buses)
117	Average Intra City Seating Capacity
118	Average Inter City Seating Capacity
119	Rate of change of occupancy % as % of gap (Intra City buses)
120	Rate of change of occupancy % as % of gap (Inter City buses)
121	Target/intended average staff number for each bus (Intra City)
122	Expected annual percentage change in staff to bus ration (Intra City)
123	Target/intended average staff number for each bus (Inter City)
124	Expected annual percentage change in staff to bus ratio (Inter City)
125	Target Operational Efficiency Intra City
126	Target Operational Efficiency Inter City
127	Target Intra city buses per route
128	Average annual rate of change of (as percent of current ratio) of Intra buses per route
129	Target Inter city buses per route
130	Average annual rate of change of (as percent of current ratio) of Intra buses per route
131	Current average operational hours - Intra City
132	Current average operational hours - Inter City
133	Average staff salary Intercity (per month)
134	Average staff salary Intracity (per month)
135	Target Operational Efficiency Inter City
136	Target Intra city buses per route
137	Average annual rate of change of (as percent of current ratio) of Intra buses per route
138	Target Inter city buses per route
139	Average annual rate of change of (as percent of current ratio) of Intra buses per route

140	Current average operational hours - Intra City
141	Current average operational hours - Inter City
142	Average staff salary Intercity (per month)
143	Average staff salary Intracity (per month)

3.List of Assumptions

S.no	List of Assumption
1	Intercity Trip rate
2	Intercity Trip rate
3	Percentage Share of Work trips of all trips
4	Percentage Share of Non-Work and tourist trips of all trips
5	Percentage Share of Educational trips of all trips
6	All buses are purchased - not rental

4.List of Outputs

S.no	List of Outputs
1	Year wise Budgetary Requirement (Crores) for Fleet and Infrastructure
2	Year Wise Budgetary Requirement for Intra and Inter City Services
3	Expected Year wise Land (Hectares) and Fleet Acquisition Requirement
4	Expected Year wise Growth in Seat Requirement
5	Expected Year wise Depot and Terminal Development Requirement
6	Year wise Intracity Bus Fleet Procurement Requirement
7	Year wise Intercity Bus Fleet Procurement Requirement
8	Expected Year wise Intracity Fleet Growth
9	Expected Year wise Intercity Fleet Growth
10	Expected Year wise Cumulative Land Requirement for Intra City Fleet
11	Expected Year wise Cumulative Land Requirement for Intercity Fleet
12	Expected Year wise Cumulative Fleet and Land Requirement
13	Expected Year wise Growth in Number of Trips
14	Expected Year wise Growth in Bus Trips
15	Expected Year wise Growth in daily Intracity passenger intracity PT Trips
16	Expected Year wise Growth in daily Intercity passenger intercity PT Trips
17	Year wise Intracity Bus Trips by Purpose
18	Year wise Intercity Bus Trips by Purpose
19	Year wise Intracity Trips by Distance
20	Year wise Intercity Trips by Distance
21	Year wise PT Intra City mode share (<=10km)
22	Year wise PT Intracity mode share (>10km)
23	Year wise PT Intercity mode share (<=10km)
24	Year wise PT Intercity mode share (>10km)

25	Expected/Planned Annual Intra City Services Efficiency Improvement
26	Expected/Planned Annual Intercity Services Efficiency Improvement
27	Annual Additional Staff Recruitment Requirement
28	Total Staff Strength
29	Expected Staff to Vehicle Ratio
30	Projected Number of Routes
31	Projected Headway (Minutes)
32	Expected Trip lengths City and Intercity
33	Expected Operating cost City and Intercity
34	Intra city - Expected Annual Operating cost, Earning and Total profit
35	Intercity - Expected Annual Operating cost, Earning and Total profit
36	Total (Intercity +Intercity) - Expected Annual Operating cost ,Earning and Total profit
37	Profit before taxes after Infrastructure development and Fleet Upgradation cost