IFD Proposed *Bus Rapid Transit (BRT)* Model for Less Developed Countries

Mabroor Mahmood

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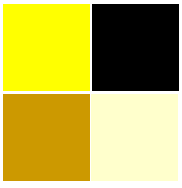

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www.ideasfd.org
ideasfd@gmail.com

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Executive Summary

Bus Rapid Transit (BRT) has long been considered to be a cost effective solution to the problems of traffic congestion in metropolitan cities. The model has been successfully implemented in various forms in many cities of North and South America, Europe and Asia. The present paper discusses this model in great detail, identifies some of its weaknesses, and proposes an alternative model that could be replicable for some low and middle income countries where industrialization process has just started.

The Bus Rapid Transit (BRT) can be defined as a bus service having a dedicated lane on the street helping the buses to run freely without any interruption from other street traffic. Unlike traditional buses, BRT buses are branded to make it attractive for all classes of passengers. The BRT buses are usually multi-coloured and identical. The dedicated lanes are generally positioned along the centre of the street, and are restricted for BRT buses only. To ensure smooth traffic of the buses, the entire bus network is centrally monitored through a computer based *Intelligent Transportation System (ITS)*.

The history of BRT dates back to 1937 when a similar service was introduced in Chicago, USA. The model was eventually replicated in St Louis (USA), Milwaukee (USA), Quito (Ecuador), Curitiba (Brazil) and many other cities around the globe. In the 1990s, Bogota, the capital city of Columbia, introduced the most modern form of BRT, thanks to the efforts of the visionary Mayor **Mr Enrique Penalosa** who played an instrumental role to make it a success. The project started after spending around USD 240 million for building the infrastructure that included a 41 km long bus way for 470 diesel-run Articulated Trunk Buses and 235 Feeder Buses. Since then, the Bogota-styled BRT model is considered to be the most suitable model for replication for addressing the problems of traffic congestion.

Although the BRT model has been successfully implemented in many cities in the world, and its impact on reducing traffic congestion is well recognized, the model has several weaknesses.

Firstly, the operation of the BRT buses are governed by the rules of a company, controlled by the existing bus operators that make rooms for abuse of power in the form of charging higher fees, compelling the investors to buy a specific brand of vehicles, etc.

Secondly, the BRT buses are unique in size, carrying capacity, and quality. It thus ignores varying level of financial capacity of the prospective investors who would be willing to invest in the sector.

Thirdly, in the traditional BRT model, there is no established linkage between the implementation of the model and the improvement of the bus manufacturing sector as a whole in the domestic economy, and

Lastly, the traditional BRT model requires the existing bus operators to dispose off their buses before transition, causing a huge financial loss, that might eventually create grounds for tensions to resist the successful implementation of the model.

The present paper proposes a new BRT model that addresses these weaknesses. The proposed BRT model is as follows:

In the proposed BRT system, there will be no umbrella company for governing the operation of the buses, rather all the buses will operate under a Government controlled regulatory body named *Mass Transit Authority (MTA)*. The first step of implementing the proposed model would be to determine the operational standard of the existing buses, and ask the existing bus owners to upgrade their buses upto a certain standard during the transition phase.

The MTA will construct some model buses and display them in a public place to enable the prospective and existing bus owners gain knowledge about the operational and design standard of the new BRT buses. MTA will set timeline for the bus owners to remodel their buses according to the fixed criteria. This will ensure smooth transition to a new system by avoiding any financial loss that is highly probable in the traditional BRT model.

However, if somebody intends to introduce a brand new bus into the system, he/she will have to comply with the ***Rules of Origin*** criteria. Rules of Origin (ROO) is a specific guideline for fixing in advance the origin of the raw materials of a particular product. Such guidelines are widely used in the multilateral and regional trade agreements.

The proposed model will use the *Rules of Origin (ROO)* requirement for developing the domestic bus manufacturing industries. Under the proposed model, the ROO will be phased in different periods. For instance, the Government might decide to take every two years as a specific period for changing the ROO.

In the first two year period, the ROO would require the producers of brand new buses to source **at least** the frame and the interior of the new bus from the domestic industries. This ROO will be gradually made more stringent in subsequent phases. As for example, in the second phase, the Rule might require the manufacturers/assemblers to source some of the components of the engine/chassis from the domestic industries as well. A Government Committee with the participation of all stakeholders will be formed that will decide on these Rules of Origin and its periodic amendments.

Therefore, the bus importers/assemblers/manufacturers will have to supply buses to the market after fulfilling the Rules of Origin, and following the design standard specified by the MTA. Thus the prospective investors will have a broad range of choices while purchasing a bus.

The periodical income of the bus owners will have to be distributed according to a variable proportion, which will depend on the ***Income Coefficient of BRT Operators***. Unlike traditional BRT model where the income is distributed on the basis of distance travelled only, the proposed *Income Coefficient* considers two more variables, i.e., the carrying capacity and the operational days of the buses. This coefficient helps to reward those bus owners who have relatively larger and technologically more efficient buses, and the buses that have travelled the most distance during the operational period under consideration.

The unique feature of the proposed model is that it not only deals with the implementation of a modern transport system , but also considers the improvement of bus manufacturing industry as a whole. In addition, it also helps to create an environment where no bus manufacturing company

will enjoy monopoly, which is a case in the traditional BRT model. This model ensures the welfare of the small and medium industries, which are directly or indirectly associated with the bus manufacturing value chain.

The inclusion of Rules of Origin is particularly important for less developed countries where the bus importers have already formed a cartel, exercising a considerable influence in the policy making process. Unless a strict Rules of Origin is attached to the model during the implementation phase in these countries, the benefits of the system will not trickle down to the domestic industrialists due to such undue influence.

The proposed model has significant development impact in the form of helping new generation of entrepreneurs to grow. The inclusion of *Rules of Origin* criteria ensures to develop the local bus manufacturing industries and its backward linkages that will have multiplier impact on the economy through technology transfer, employment generation, cross border investment, import substitution, etc.

If the host countries become self sufficient in the bus manufacturing industry, it will also open opportunities for exports in other countries where manufacturing of buses have become expensive. Moreover, due to the Rules of Origin requirement, the bus manufacturing companies of the developed countries will be encouraged to relocate their plants to the host countries, causing a significant inflow of foreign direct investments.

IFD Proposed *Bus Rapid Transit (BRT)* Model for Less Developed Countries

I. Introduction

Traffic congestion now a days has become a perennial problem in many countries. It is affecting the daily life of the citizens with huge loss of productivity through wastage of working hours that indirectly impact the overall economic growth of the domestic economy. Amongst the cities that have been suffering from chronic traffic congestion, the news of Dhaka, Tehran, Lagos, and Dubai have appeared in the international press during the recent periods, proving the severity of the problem. In Dhaka alone, it is estimated that economic activities worth millions of dollars are being lost due to horrific traffic congestion that take place every day on the streets of the metropolis.

Bus Rapid Transit (BRT) has long been considered to be a cost effective solution to the problems of traffic congestion in metropolitan cities. The model has gone through continuous modifications over the last century, and has been successfully implemented in various forms in many cities of North and South America, Europe and Asia. The present paper discusses this model in great detail, identifies its apparent weaknesses, and proposes an alternative model that could be replicable in some of the less developed countries, which have been suffering from traffic congestion for a long time.

II. The Definition of BRT

The Bus Rapid Transit (BRT) can be defined as a bus service having a dedicated lane on the street through which the buses can run freely without any interruption from other street traffic. Although BRT is similar to regular bus service in any metropolitan city, it has some features that have made it unique and distinguishable. These are as follows:

- Unlike regular buses, BRT buses are branded to attract all classes of passengers. The BRT buses are generally smart looking, multi-coloured, and identical. The interior of the buses are usually eye-catching and spacious and the stations are designed in an elegant manner. People, especially from the upper class, are usually reluctant to ride on street buses because they feel that buses are cheap transport and meant for under privileged class of the society. But in case of BRT, such feelings are absent because the buses are branded and designed in a manner that suit the taste of all classes of population.

- BRT buses have dedicated lane on the streets that are restricted for BRT buses only. Therefore, the traffic congestions on other lanes do not affect the free movement of BRT buses.

- In case of BRT, these dedicated lanes and the bus stations are usually built on the centre of a street. In regular bus service, the stations are usually built in one side of the street, requiring the buses to change lanes before they stop for loading and unloading the passengers. Such frequent change of lanes reduces the speed of traffic flow on the street, causing traffic congestion. But in BRT, such congestions are reduced by building the stations and the dedicated lanes in the middle of the streets.

- Unlike regular bus service, the BRT buses get priority in every traffic signal. Therefore, the movement of BRT buses are much faster than the traditional buses, helping the passengers to reach their destinations very quickly. These faster movements encourage people to use BRT buses more and depend less on private cars. So the number of private cars gradually decreases on the streets, making the movements of all sorts of traffic much faster.

- In every BRT station, there is usually an additional *passing lane* to help an incoming BRT bus to cross another bus staying on the station for boarding passengers. This allows the Express BRT Buses to move much faster than Local BRT Buses that stop in every station.

- In BRT, the entire bus network is monitored by a computer aided *Intelligent Transportation System (ITS)*. So the ITS officials can continuously monitor the movement of the buses to check whether any bus is stuck on the lane, disrupting the free movement of other buses.

- The operation of the BRT buses are usually governed by the rules of a company. The income of the bus operators are calculated on the basis of distance travelled. It helps to reduce competition for grabbing passengers, a prime cause for traffic congestion in the less developed countries. Each driver receives a fixed salary, and their salary package is not tied to the number of passengers they carry.

- The main bus route is called the *Trunk Route* and the supplementary routes are called *Feeder Routes*. Every Trunk Station is connected with the Feeder Station with foot over bridges, under passes or sidewalks. So the passengers can avail a larger Trunk bus, get down in a Trunk Station, move to a Feeder Station, and reach their desired destination by riding on a Feeder Bus. Trunk routes are usually served by large sized *Articulated Buses* that can carry almost 160-200 passengers at a time, while the feeder routes are served by smaller sized *Feeder Buses* having carrying capacity of around 80-100 passengers.

An Articulated Trunk Bus[1]

A Feeder Bus[2]

III. The History of the BRT

The history of BRT dates back to 1937 when a similar service was introduced in Chicago, USA. At that time, some train lines were converted to bus lanes, and a dedicated lane-based bus service was introduced to carry passengers. Eventually the model was replicated in other US cities, such as, Washington DC in 1955, St Louis in 1959, and Milwaukee in 1970.

The first middle centred dedicated bus lanes were built in St Louis in 1966, and the same model was introduced in Liege, Belgium in the same year.

Although the US is considered to be the pioneer of BRT services, the modern BRT service was first introduced in Brazil. During the 60s and the 70s, when the traffic congestion became a gruesome

[1] *Photo Source:* US Department of Transportation
[2] *Photo Source:* US Department of Transportation

issue in many Brazilian cities, constructing a metro rail system was then considered to be a viable remedy of the problem. But the attempts were failed due to the high costs involved. So in 1975, Brazilian city of Curitiba first introduced the cost efficient modern BRT system as a substitute for expensive metro rail. Mr Jaime Lerner, the then Mayor of Curitiba, played instrumental role for making this initiative a success. Eventually the same model was replicated in some other Brazilian cities.

The system then cost around USD 54 million. The quite surprising fact is that although this modern BRT system reduced traffic congestion significantly, the model was not replicated in other Latin American cities until 1990s. The lack of political will of the officials concerned was the prime reason behind such a delay.

The Quito of Ecuador introduced this modern BRT system in 1996, and at the same time, the model was also adopted by some of the Asian cities, like Kunming of China.

Although the model was introduced in many cities around the world during the last decades, BRT was widely perceived to be a model suitable only for the small cities. But Bogota, the capital of Columbia, proved it as a misconception in the early 2000s by showing that the traffic congestion in the large cities could also be significantly reduced with the help of BRT.

The Interior of TransJakara BRT in Indonesia[3]

In December 2000, Bogota introduced a Brazilian style BRT system under the brand name of *TransMilenio*, thanks to the instrumental role played by **Mr Enrique Penalosa**, the then Mayor of Bogota. During 1998-2001, Mr Penalosa transformed the landscape of Bogota's inefficient transport

[3] *Photo Source:* Internet

network. He not only reformed the age old bus service, but also brought new innovations by improving sidewalks and making separate lanes for bicycles.

In order to materialize his vision, Mr Penalosa had to spend USD 240 million to complete the infrastructure during the first phase of the project. In the first phase, 41 km long bus way was constructed with 470 diesel-run Articulated Trunk Buses and 235 Feeder Buses. The second phase added another 335 Articulated Trunk Buses and 200 Feeder Buses. The carrying capacity of each Articulated Bus was 160 passengers, while each Feeder Bus could carry 80 passengers.

In 2004, the same Bogota BRT Model was replicated in Jakarta, Indonesia under the brand name of *TransJakarta Rapid Transit*. Beijing, the capital of China, saw the system implemented in December of the same year.

In all the cities mentioned above, the BRT proved to be a sustainable model for reducing traffic congestion. In Jakarta, a great reduction of traffic volume has been observed within few months of introducing BRT. The same is true for Bogota, Quito, and all other cities where traffic congestion was a perennial problem during the past decades.

TransMilenio BRT in Bogota, Columbia[4]

[4] *Photo Source:* Institute for Transportation & Development Policy, USA

IV. The Weaknesses of the BRT Model

Although the BRT model has been successfully implemented in many cities in world, and its impact to reduce traffic congestion is well recognized, the model has the following weaknesses:

- The BRT buses are governed by the rules of a company, which is usually incorporated with the participation of existing bus operators. Therefore, it is highly probable that the control of the company will remain with a small group of people, who might abuse such power if there is a lack of regulatory mechanism.
    - For instance, in most BRT models, the buses are supplied by only one or two bus manufacturing companies that enjoy a complete monopoly in supplying the buses. Such a monopoly compels the general investors to have very few choices while purchasing the buses. The monopolistic power of the bus manufacturing companies as well as the controlling authority of a small cartel occupied by the existing bus owners might act as an incentive for creating grounds for corruption in the forms of charging unnecessary fees, fixed maintenance contracts, higher purchase price of the buses, etc.
- The BRT buses are unique in size, carrying capacity, and quality. It thus ignores varying level of financial capacity of the prospective investors who would be willing to invest in the sector. As a result, a person cannot invest in the BRT system unless he/she has the sufficient wealth to buy a specific brand of articulated or feeder buses.
- The income of the buses is distributed amongst the bus owners on the basis of distance travelled only. If the buses remain idle or out of order, the owners are penalized, however, this penalty is not integrated with the income sharing formula.
- In the traditional BRT model, there is no established linkage between the implementation of the model and the improvement of the bus manufacturing sector in the domestic economy. If the host country has a strong group of importers, it is very likely that the BRT model would be implemented with the use of imported vehicles, causing a huge drain of foreign currency from the host country. This is particularly true for most of less developed countries where quality of governance mechanism is poor and the business sector is largely dominated by the large importers.
- The traditional BRT model compels the existing bus owners to dispose off their old buses within a stipulated time period and replace them with new BRT buses, resulting financial losses. Such losses can be high enough to encourage the existing bus owners to resist the successful implementation of the model at any cost.

V. IFD Proposed BRT Model

In the next section, a new BRT model is proposed that addresses all the weaknesses mentioned above. This proposed model will not only reduce traffic congestion on the street, but at the same time, will also help to develop the bus manufacturing industries and its backward linkage engineering sectors of the domestic economy. Moreover, the proposed model has been structured to encourage people to be entrepreneurs and invest in the bus operating industry at ease without thinking of losing his/her control over the operation of their respective buses.

In the sections below, only the features that made this model unique and distinguishable from the traditional model have been highlighted. The remaining features are identical to the traditional BRT model and can be found in any international literature on BRT.

The Beginning

- In the proposed BRT system, there will be no umbrella company for governing the operation of the buses, rather all the buses will operate under a Government controlled regulatory body named *Mass Transit Authority (MTA)*. This authority will formulate the rules of operation, and any investor can join this Government guided integrated computer based system with any number of buses he/she wants.

- The MTA will first decide on which route it wants the BRT operation to start as a pilot project. Before introducing the new BRT buses in the routes, the MRT will determine the number and the operational standard of the existing buses that are already operational in this route.

- Following the determination of the operational standard of the existing buses, the bus owners will be asked to upgrade their buses upto a certain standard. For instance, the MTA might ask the owners to brand their buses with a specific colour and a brand name, stamp a fixed logo on the buses, upgrade the interior amenities, improve the sitting arrangements, etc.

- After determining this specific and unique standard for all bus owners, the MTA will set a timeline for the bus owners to bring the required changes in their existing buses. If somebody fails to bring changes within the set timetable, he will not be allowed to operate his bus when the BRT operation starts.

- The MTA will construct some model buses and display them in a public place that will help prospective and existing bus owners to gain knowledge about the operational and design standard of the new BRT buses. After examining these model buses, all bus manufacturing enterprises and the associated engineering units will take necessary preparation for constructing similar buses in the future.

- The MTA will set a fixed date for the new remodeled BRT buses to start operation. No bus owner will be allowed to operate the remodeled BRT bus before this date. After the

remodeling is done, MTA Inspectors will issue certificates on the operational and design standards of the buses.

- After the system is introduced, the weekly/monthly income of the bus owners will be published in a report format. This will help the general people to know about the profitability of such investments.

Rules of Origin

- Under the proposed BRT model, if somebody wants to introduce a completely new bus into the system, he will have to comply with the ***Rules of Origin*** criteria. Rules of Origin (ROO) is a specific guideline for fixing in advance the origin of the raw materials of a particular product. This guideline is widely used in the multilateral and regional trade agreements.

- The proposed model will use the *Rules of Origin* criteria for developing the domestic bus manufacturing industries. Before discussing in detail about the features of the proposed ROO, the nature of business of some of the stakeholders associated with the bus manufacturing industry needs to be elaborated. The following Table illustrates a brief description of each of these stakeholders:

The Stakeholders in the Bus Manufacturing Value Chain

Stakeholder	The Role
Importer 1	These importers import a complete bus from abroad and sell it to the domestic customers. They act as agents of various international bus manufacturing companies.
Importer 2	They import chassis of a bus from abroad, and then sell the chassis to the domestic enterprises that make bus frames. Sometimes, they also make the frames themselves, and sell the complete bus to the local customers.
Bus Assemblers	They import spare parts in pieces and assemble a complete bus by joining them together.
Bus Manufacturers	They manufacture a complete bus with their own technology. The process is complex and thus requires high level of industrial sophistication. Therefore, there are few less developed countries that have these stakeholders.
The Frame Manufacturers	They manufacture bus frames only and add all the interior elements into a chassis, and eventually sell the complete bus to the customers.
Parts Manufacturers	They manufacture various parts/components of an engine and the chassis and sell them to the bus manufacturers.
Tire Manufacturers	They produce tires for buses.

Under the proposed model, the Rules of Origin will be phased in different periods. For instance, the Government might decide to take every two years as a specific period for changing the Rules of Origin.

In the first two year period, if somebody intends to introduce a brand new bus into the system, the ROO would require him to source **at least** the frame and the interior accessories from the domestic industries. Only the chassis could be imported from abroad during the first phase of the ROO. Therefore, the Importers 1 in the above Table would not be allowed to sell their buses for the newly introduced BRT system.

Therefore, in the first phase, the stakeholders starting from Importers 2 and below would be benefitted from the Rules of Origin.

These Rules of Origin will be gradually amended and made more stringent. For instance, in the second phase, besides the frame and the interior accessories, the Rule might require the operators to source some of the parts/components of the engine and the chassis from the domestic industries. So in this stage, the parts manufacturers will have a guaranteed market for their products.

A Government Committee with the participation of all stakeholders will be formed that will decide on these Rules of Origin and its periodic amendments. Those parts manufacturers or other upstream entrepreneurs willing to include their products into the ROO list will apply for such inclusion. The committee will then examine the standard and prices of the products, and eventually include them in the ROO list if they pass the minimum standard test.

The activities and decisions made by the Committee will be governed by the following fundamental rules:

- There has to be transparency in making a decision;
- The decision should not be biased for political reasons and no country of origin can be excluded from the list just because of political conflicts;
- The Rules of Origin has to be predictable for all the stakeholders;
- There will be no assurance for the domestic manufacturers that their products will pass the stress test very easily. All domestic manufacturers have to prove their ability to manufacture products of international standard in terms of quality and price that can compete with foreign products.

The Structure of the Bus Depot

There has to be a bus depot at one end of each bus route. Traditionally bus depots are constructed horizontally where buses are parked in a wide space requiring huge amount of land. Such a horizontal design is expensive for those countries where the land is scarce. So if a similar bus depot is constructed in a vertical shape, where buses will be parked in a building like structure, the overall cost can be significantly reduced.

Each vertical bus depot can have dedicated space for the parking of the BRT buses, bus maintenance workshops, offices, clubs for the drivers, restaurants, service centers, etc. Every bus parking bay will have arrangement for gas and water connections for servicing the buses. As a result, the buses won't have to move to another floors frequently to be serviced.

Whenever a bus arrives the depot, the bus driver will hand over the key to the depot managers for taking care of servicing the bus and providing the required security. So every morning the drivers will come to the depot and drive out the bus for carrying passengers without thinking about servicing the bus or its security. The bus depot management will charge a fixed fee to the bus owners for providing this routine service. Such a depot can be constructed with private finances, or jointly with the Government under a PPP initiative.

Distribution of Income

The periodical income of the bus owners will have to be distributed according to a pre determined proportion. To determine the income share of each bus owner, the *IFD Income Coefficient of BRT Operators* will have to be used. The calculation of the coefficient is as follows:

IFD Income Coefficient for the BRT Operators[5]

$$ICx = \left\{0.5\ X\ \left(\frac{TCx}{TCn} + \frac{MDx}{TMD}\right)\right\}\ X \frac{DOOx}{MDOO}$$

Where,

IC_x = Income Coefficient of Bus 'X"

TC_x = Total Capacity of Bus 'X' in terms of Number of Passengers
TC_n = Total Capacity of All Buses in terms of Number of Passengers

MD_x = Miles Driven in a Year by Bus 'X'
TMD = Total Miles Driven in a Year by All Buses

DOO_x = Days of Operation in a Year by Bus 'X'
MDOO = Maximum Possible Days of Operation in a Year By Any Bus or 365 days

Example

For instance, there are only 10 BRT buses in a system. Each bus has the carrying capacity of 80 passengers. These buses can operate maximum 365 days in a year. Each bus can run for around 22,000 km in a year. If all the buses operate in a year, their income will be USD 1,000,000. Now the distribution of this USD 1 million amongst the 10 bus owners has been illustrated in Table 1(a).

It is evident in the Table that each bus owner has the same distribution of income (USD 100,000) since the carrying capacity, period of operation, and the distance travelled are same for all buses.

[5] For formulating this coefficient, the assistance received from Mr Murad Yandiev is highly appreciated.

However, the distribution of income will change if the above mentioned three parameters change, as it is evident in Table 1(b).

From the Table 1(b), it is observed that since the bus 1 has higher carrying capacity, its owner has a higher share in the total income of USD 1 million. On the other hand, since the bus 2 has lower operational days, its owner's income is proportionately reduced. The same happens for bus 5. Although this bus has higher carrying capacity, its operational days are lower.

In this example, if all the buses have the same carrying capacity and travelled distance, then those buses which will have lower operational days will have lower share in the total income. All other buses will have the same USD 100,000 income. So the buses having lower operational days will be penalized, and will receive lesser share of USD 1 million income compared to the other buses. The savings resulted from such penalty can either be deposited in a joint fund for the welfare of the industry, or it can be given to the most operational bus owner as a reward.

Table 1(a): Calculation of Income Coefficient for the BRT Operators

Bus No.	Bus Capacity (TC)x	Total Bus Capacity (TC)n	Days of Operation in a Year (DOOx)	Max. Days of Operation (MDOO)	Km Driven in a Year by One Bus (MD)x	Total Km Driven by All Buses (TMD)	Coeff. For Capacity	Coeff. For Km Driven	Coeff. Of Operation	Income Coefficient for Bus Operator X (Icx)	Total Income (USD)	Income of a Bus Operator (USD)
	1	2	3	4	5	6	7	8	9	10	11	12
							(1/2)	(5/6)	(3/4)			(10X11)
1	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
2	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
3	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
4	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
5	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
6	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
7	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
8	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
9	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
10	80	800	365	365	22000	220000	0.100	0.100	1	0.100	1,000,000	100,000
Total	**800**	**420**			**220000**		**1**	**1.000**	**10**	**1.0**		**1,000,000**

Table 1(b): Calculation of Income Coefficient for the BRT Operators

Bus No.	Bus Capacity (TC)x	Total Bus Capacity (TC)n	Days of Operation in a Year	Max. Days of Operation	Km Driven in a Year by One Bus (MD)x	Total Km Driven by All Buses	Coeff. for Capacity	Coeff. for Km Driven	Coeff. of Operation	Income Coefficient for Bus Operator X (ICx)	Total Income (USD)	Income of a Bus Operator (Tk)
	1	2	3	4	5	6	7	8	9	10	11	12
							(1/2)	(5/6)	(3/4)			(10X11)
1	160	960	365	365	22000	217000	0.167	0.101	1	0.134	1,000,000	134,025
2	80	960	340	365	20000	217000	0.083	0.092	0.9315068	0.0817	1,000,000	81,739
3	80	960	365	365	22000	217000	0.083	0.101	1	0.092	1,000,000	92,358
4	80	960	365	365	22000	217000	0.083	0.101	1	0.092	1,000,000	92,358
5	120	960	350	365	21000	217000	0.125	0.097	0.9589041	0.106	1,000,000	106,330
6	120	960	365	365	22000	217000	0.125	0.101	1	0.113	1,000,000	113,191
7	80	960	365	365	22000	217000	0.083	0.101	1	0.092	1,000,000	92,358
8	80	960	365	365	22000	217000	0.083	0.101	1	0.092	1,000,000	92,358
9	80	960	365	365	22000	217000	0.083	0.101	1	0.092	1,000,000	92,358
10	80	960	365	365	22000	217000	0.083	0.101	1	0.092	1,000,000	92,358
Total	**960**	**420**			**217000**		**1**	**1.000**	**9.890411**	**0.989**		**989,433**

In the traditional BRT model, the income of the bus operators is distributed according to the distance travelled only. The carrying capacity of the buses or their operational days do not influence the income of the bus owners. One of the reasons of not considering these factors is that all the buses in a traditional BRT model are usually unique and manufactured by the same company.

Features of the Co-efficient

- The coefficient considers only the total carrying capacity of the buses. It does not consider how many passengers actually travel with the bus. As a result, the actual number of passengers travelled will not impact the income of the bus owners.

- The coefficient considers operational days of a bus. Therefore, if a bus remains out of order for few days, it will adversely impact the income of the bus owner.

- The coefficient also considers the distance travelled by each bus. Therefore, if a bus goes out of the depot, remains out of order for few hours, and then again comes back to the depot after fixing the mechanical problem, then the income of that particular bus owner will drop. Since the coefficient considers both the distance travelled and the total operational days, it encourages bus operation for everyday in a given time period week.

- The coefficient indirectly discourages the owners to operate the bus continuously for 72 hours and then remain idle for the next 48 hours. It also discourages the owners to operate the bus during the lean season and claim higher share in the income by increasing distance travelled, but keep the buses idle during the peak season when the demand for buses is very high.

- Since this coefficient considers the carrying capacity, distance travelled and also the operational days, it will favour those bus owners who have relatively larger buses, buses of improved technology and the buses that have travelled the most distance and have been operational during the whole period under consideration. As a result, these owners will have larger share in the income, and at the same, the quality and durability of a particular bus will also be reflected. The traditional BRT model does not have this particular feature as all the BRT buses are unique in size and carrying capacity, and is usually supplied by the same company.

  This will encourage the new bus owners to buy those buses, which have proved to be technically more efficient, durable, and larger in size. So there is no opportunity for a bus manufacturing company to enjoy monopoly in the proposed model. Eventually, everybody will move towards those buses which are technologically more advanced, long lasting, and having larger carrying capacity.

VI. Advantages of the Proposed Model

- The unique feature of the proposed model rests on the fact that it not only deals with the implementation of a modern transport system , but also considers the improvement of bus manufacturing industry as a whole. In addition, it also helps to create an environment where no bus manufacturing company will enjoy monopoly, which is a case in the traditional BRT model. This model ensures the welfare of the small and medium industries, which are directly or indirectly associated with the bus manufacturing value chain.

- It is to be noted that the countries that have already implemented BRT model, are usually technologically advanced and are ranked either as developed or developing nations. Some of these countries have a rich history of industrial advancement, and manufacturing a bus from scratch is no longer considered to be an appreciable achievement in these countries.

  However, the cases of less developed countries are different. Most of the less developed countries are poor and their industrial advancement is still in the nascent stage. Therefore, if BRT model is implemented in these countries, it will be very difficult to ensure the welfare of the domestic industries due to the strong lobby of the importers. Unless a strict Rules of Origin is adopted during the implementation phase, the benefits of the system will not trickle down to the domestic industrialists due to this limitation.

- This model does not compel the owners to buy a bus of a particular brand or size. Under the model, the governing body will determine the minimum standard and requirement, and maintaining these set standards, the bus manufacturing companies will offer buses of various technologies, sizes and brands to the prospective clients.

  The customers will eventually buy the buses according to their financial capacity. Therefore, one investor might own one double decker bus, while another might own 10 articulated buses, and both will receive their proportionate share in income according to the carrying capacity, distance travelled and operational days. Such an opportunity for open selection of bus will encourage the bus owners to gradually converge to those buses which are technologically more advanced, durable and larger in size, making the whole bus manufacturing industry more competitive.

- The model will encourage individuals to be investors, reduce their risk aversion attitude, and start new business ventures. Therefore, the number of entrepreneurs in the society will increase. This model will open a new window of opportunity for the retired people, women, service holders, and other professionals who have a large pool of funds, but do not have adequate lucrative investment opportunities.

- The Bogota BRT model replaced the old buses completely with the new buses. If a Government wishes to implement such a model with complete replacement of existing buses, it might create tensions amongst the existing bus owners, and simultaneously, the banks that have extended loans to these bus operators might also be affected. The proposed model offers a remedy to such potential problems by keeping an opportunity to convert the existing old bus to a new bus by bringing some changes in the structure, and interior.

Therefore, the transition of the existing old transport system to the new BRT system would be much smoother under the proposed model.

- If the proposed model is successfully implemented through the adoption of Rules of Origin, many industrially advanced countries will relocate their bus manufacturing plants to the host country to take advantage of the increased demand for new buses as well as the Rules of Origin. Therefore, the flows of Foreign Direct Investment (FDI) will increase in the host country, which will have multiplier impact in the whole industrial value chain.

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