NOTES AND COMMENTARIES

presents preliminary research, review of literature and comments on published papers or on any relevant subject

Innovative Strategic Management: The Case of Mumbai Suburban Railway System

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Executive Summary

Business organizations today have to survive and grow in a turbulent and volatile business environment. Continuous metamorphosis in technology, competition, inconsistent government policies, group dynamics of employees and militant unions, rational customers and their forums have been constantly reminding them to be more vigilant.

Generation and rendering of services is often more vulnerable as services are perishable and dynamic. The strategic management of any service sector must be innovative and sustainable. Efficient urban transport systems are critical elements of the sustainable development of urban areas. This paper presents the innovative strategic management system of Mumbai Railway Vikas Corporation (MRVC) in addressing the Mumbai suburban public transport problems. An incredible 88 per cent of all travel in Mumbai is by bus and rail; this illustrates the popularity and necessity of having an effective and efficient public transport system, particularly the railways.

The paper outlines a case study of US $2.5 billion expansion and improvement of the Suburban Railway Network, as a part of the multi-modal Mumbai Urban Transport Project (MUTP). Increase in suburban trains in Mumbai has not kept pace with the passenger demand and therefore loading in the existing suburban trains have increased and the travelling conditions in the trains have become unbearable. The paper gives an insight into the process of building social and political consensus while taking into consideration the aspirations of people for conducive and comfortable commutation. The diverse but integrated objectives that were achieved holistically, is indeed through innovative strategic management that led MRVC to attain customer satisfaction, energy conservations, socioeconomic benefits, environmental upgradation through afforestation, rain water harvesting, and noise reduction. MRVC is doing rain water harvesting, mangrove plantation, tree plantation and transplantation to compensate for cutting of tress at project sites. A glaring example of an infrastructure project that aptly envisaged ecological balance and environmental and social upgradation of slum dwellers. Innovative improvement in commuters' amenities including ventilation system, GPS-based passenger information system, pneumatic suspension for comfortable riding, etc., have enhanced customer satisfaction that is required for a long-term business growth.

KEY WORDS

Strategic Management

Public-Public Partnership

Service Sector

Energy Conservation

Socio-economic Benefits

The current business world is highly turbulent and volatile meshed with uncertainties, and organizations are expected to survive and grow in such business environment. Constant advancement in technology, untold cut-throat competition from rivals, unreasonable government policies, workforce group dynamics, intimidations from well-established militant unions, increase in the number of rational customers and their defending weapons like consumer forums have been forcing these organizations to becoming more alert and vigilant. No matter how important intuition and experience of management are, it is necessary not only to scan the business environment for identifying emerging business opportunities and capitalize on them but also identify the possible threats and business environmental intimidations and carve out strategies to mitigate them. All these need innovative strategic management that is aimed at setting overall business objectives, evolving vibrant strategies to pursue the pre-determined objectives by aligning the individual goals with the organizational goals, and strategically controlling the objectives with an inbuilt corrective mechanism to enable organizations to survive and grow continuously.

Strategic management incorporates plans for all the functional areas, viz., financial, marketing, human resources, operations and material managements. However, all the plans eventually have to be converted into financial data, and therefore, in a micro sense, a strategic plan may be considered as a strategic financial plan.

REVIEW OF LITERATURE

Strategic management is a *sine qua non* for large organizations; it helps them develop a unifying framework for planning and decision making. The concept of strategic management is vague and obscure. Nevertheless some luminaries in the area have defined it as follows. According to Gerry and Kevan (2005), strategic management involves understanding the strategic position of an organization, strategic choices for the future, and turning strategy into action. John, Richard and Amita (2008) define it as the set of decisions and actions that results in the formulation and implementation of plans designed to achieve a company's objectives. The strategic management process is intended to be a rational approach to help a firm respond effectively to the challenges of the 21st century competitive landscape (Hitt, Ireland and Hoskisson, 2001). In the words of Peter Drucker (1962), strategic management is the continuous process of making present entrepreneurial decisions systematically and with the best possible knowledge of their futurity, organizing systematically the efforts needed to carry out these decisions and measuring the result of these decisions against the expectation through organised systematic feedback. Strategic management (corporate planning) is the formal process of developing objectives for the corporation and its component parts, evolving alternative strategies to achieve these objectives and doing this against the background of systematic appraisal of internal strengths and weaknesses and external environmental changes, and the process of translating these plans into action (Hussey, 1974) . According to Rao and Sarin (1973), corporate planning is the process of formulating objectives as well as developing and evaluating alternative course of action to reach these objectives, on the basis of identified external opportunities and threats and internal corporate strengths and weaknesses. Corporate planning is a systematic and disciplined study designed to help identify the objectives of any organization or corporate body, determine an appropriate target, decide on suitable constraints and devise a practical plan by which the objectives can be achieved (Argenti, 1968).

From the above definitions, it may be concluded that strategic management has a wide coverage; it establishes a link among the different units of the organization, involves formulation of objectives for the organization, and provides guidance to the organization towards its attainment. In fact, objectives are nothing but an end result of specified endeavours.

Services are perishable and dynamic in nature. Delivery of public utility services through a public enterprise particularly faces various problems. In fact, social, political and environmental threats today pose a much severe problem than financial risks for a public enterprise. Use of public funds requires a balancing act between judicious use of funds and meeting the aspirations of common man. Within the service sector, public transport system experiences a very turbulent environment. An efficient urban transport system (www.lara.prd.fr) is a critical element of the sustainable development of urban areas. This paper presents the innovative strategic management system of the Mumbai Railway Vikas Corporation (MRVC) in addressing the Mumbai suburban public transport problems.

MUMBAI SUBURBAN RAILWAY SYSTEM

The Background

Mumbai is a linear city, spread over a distance of 120 kms. During the early part of the 20th century, Britishers realized that to exploit the full commercial potential of Mumbai, it would be necessary to provide an electric-based transport system for the people of Mumbai. Electric suburban trains were introduced in Mumbai in 1925 with 1500V Direct Current (DC) traction system. It may be mentioned here that at that time, DC was the only modern traction system available with the London Underground. An incredible 88 per cent of the overall travel in Mumbai is by bus and rail. This statistic in itself illustrates the popularity and the necessity of the public transport system, particularly the railways. The trains can carry four times the traffic load of city buses in terms of passenger kms of travel. The local trains carry 6.6 million passengers every day. Although the normal capacity of each train is 1,700 during peak hours, more than 5,000 people crowd into them.

The Mumbai suburban railway network in the Central and Western Railways covers a route of 319 kms. There are five corridors, two on the Western Railway, two on the Central Railway, and one on the Harbour Line. Every day 6.6 million people travel in the suburban section using the services of 2,435 trains. In fact, record suggests that the suburban section of Mumbai has the highest passenger density in the world. Against the original design offering a capacity of 1.800 passengers (900 sitting plus 900 standing) per nine-car train, at present a nine-car train, carries 5,000 passengers (900 sitting plus more than 4,000 people in standing condition) during peak hours. This has resulted in, what is known as, super dense crush loading conditions in Mumbai resulting in a passenger loading of 16 passengers per square metre, which is the highest in the world.

The Mumbai suburban railway network, 'Local' train as it is called in local parlance, is the life line of Mumbai. The salient statistics of suburban sections of the Western and Central Railways are given in Table 1.

Major Problems

Over the years, the commercial activities in the city of Mumbai have increased and mainly due to influx of population from the neighbouring states, the suburban sector of Mumbai faces the following problems:

Table 1: Salient Statistics of Western and Central Railways

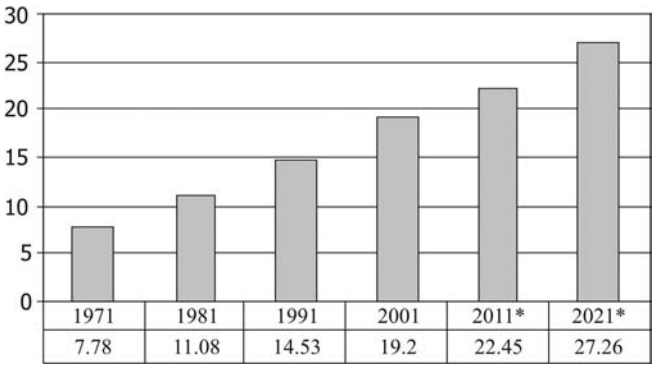
	Central Railway	Western Railway	Total
Number of stations	73	28	101
Route kms	263	56	319
Traction	15,00V DC/ 25 kV AC	15,00V DC/ 25 kV AC	
Number of trains run per day	1,308	1,127	2,435

Source: Records of MRVC

Inability to Meet the Demand

An abnormal increase in population (Figure 1) and growth of suburban traffic leads to overloading in the trains.

Figure 1: Population Growth in Mumbai



* Projected

Source: www.mmrdamumbai.org

Mumbai being the commercial capital of India, offers a large number of employment opportunities thus attracting a large number of people from rural and semi-urban areas of India. An affordable monthly season ticket (approximately a distance of 500 kms can be covered in US $1 by the passengers) has made suburban transport system the main mode of transport for the people of Mumbai. Given the geographical spread of population from south to north and the location of central business district in the south, the suburban rail network will continue to be the principal mode of mass transit in Mumbai. At present, 6.6 million commuters of Mumbai use the existing facilities everyday. In spite of heavy demand, the railways have successfully provided efficient and reliable service so far. The pressure on the existing suburban network has continued to grow exponentially and has reached the saturation level. It is felt that urgent action is required to tackle

the deteriorating conditions of suburban travel in Mumbai.

Poor Travel Comfort

The increase in suburban trains in Mumbai did not keep pace with the passenger demand and because of overloading, the conditions in these trains deteriorated. This observation is substantiated by Table 2. Due to mushrooming growth of housing colonies, passenger loading in the already overloaded suburban trains has exceeded the tolerable safe limits making the travelling conditions poor and uncomfortable. A passenger-friendly environment has been missing inside the old EMU coaches. The windows of the coaches are small. The quality of grab handles and seats is also not up to the mark. The partition panels inside the coaches are made of sunmica. Thus the overall ambience inside the coaches is poor. In the existing coaches, an illumination level of 100 lux is provided,which is not considered satisfactory by the passengers.

Lack of Investment

All over the world, traditionally, the suburban/metro network operation, including the buses, falls under the purview of the Central Government which also absorbs the operating losses. In the suburban areas of Mumbai city (Borivali-Virar, Kurla-Thane-Kalyan sectors, etc.), a large number of housing colonies have been set up. The development charges collected by the State Government from the construction sector were not used for the expansion of suburban systems in Mumbai. As a consequence, the existing suburban system was patronized neither by the Central Government nor by the State Government, mainly due to the requirement of huge amount of funds. Over the last fifty years, it has been observed that even though the number of passengers carried have grown by 792 per cent, the number of trains have increased only by 282 per cent, thus each train on an average being overloaded by 281 per cent.

High Energy Consumption and Inability of Obsolete Technology to Tackle Additional Traffic

As already discussed, the Mumbai suburban railway system operates on 1,500V DC traction system, which was introduced in 1925 along the lines of the London Underground Metro System. With the increase in loading, each 12-car train draws 5,000 amps from the system. When two trains are leaving and two trains are reaching the Churchgate station, approximately 10,000 to 15,000 amps of current is drawn from the system. Due to this large requirement of current, many traction substations have been set up, e.g., there are 20 DC traction substations between Churchgate and Virar, a distance of 60 kms. At present, in almost every station, there is a traction substation. For increasing the suburban services and number of coaches per train, additional substations need to be set up, which is not considered advisable from the technical safety consideration. Thus, it is quite clear that due to drawal of large amount of current by the trains, it has become impractical to increase the number of trains and add additional number of coaches in each train. Therefore the need to have 25,000V traction system was felt.

Encroachments in Railway Land

When large number of people migrated to Mumbai from other cities and rural areas of Maharashtra and other states, the surplus vacant railway land available in Mumbai suburban sections became a soft option for encroachment. And, when the need to increase the number of railway corridors in Mumbai was felt, it became difficult to get the encroached railway land vacated from encroachers.

Also, since the encroachers were staying near the existing railway tracks, the train speed was curtailed to 30 km/per hour for safety considerations and this led to reduction in line capacity.

Table 2: Suburban Traffic Growth in Mumbai

	1951-52	1961-62	1971-72	1981-82	1991-92	2001-02	2004-05	% Increase from the Year 1951-52
Passenger carried (millions)	292	454	915	1,459	1,795	2,275	2,314	792.47%
Average trip length (Kms)	13.8	14.0	16.5	18.8	22.5	26.9	29.6	214.49%
Passenger Kilometers (millions)	4,031	6,365	15,123	27,392	40,462	61,195	68,362	1,695.91%
No. of trains per day	741	960	1,161	1,577	1,889	2,055	2,441	329.42%

Source: Indian Railway Statistical Manual

Limitation of Carrying Capacity in the Existing Corridors

The existing corridors, operating mail/express, freight, passenger and suburban trains are being utilized to their full capacity and it has been difficult to increase the number of services in the existing system. In order to create extra carrying capacity to run additional trains, new additional corridors will have to be set up.

Obsolete Design of the Existing Trains

The design of the existing trains in Mumbai has practically become obsolete and the following problems are being faced by the commuters:

- Lack of ventilation is a major problem in Mumbai suburban trains. During peak periods, CO_2 level inside the coaches is as high as 2,500 ppm., making passengers feel uncomfortable.
- Trains do not run smoothly and passengers experience jerks particularly while braking.
- Insufficient illumination levels inside the coaches make it difficult for commuters to read during their journey.
- Use of DC series motors and cumbersome design of bogies and traction equipment lead to the need for excessive maintenance.

The large number of standing passengers block the doors and windows of the suburban trains, thus creating difficult conditions inside the coaches. Apart from the above, in the existing trains, physical barriers in the semi-bulk head partitions have been provided which also obstruct free circulation of air from one end of the coach to another. In order to measure the CO_2 level inside the coaches, during peak periods, a portable CO_2 measuring equipment was procured by MRVC. Actual measurement during peak periods revealed that CO_2 level inside the coaches goes as high as 2,500 ppm against the ambient levels of 600-700 ppm of CO_2 available in the open air. This high level of CO_2 inside the coaches is harmful to the commuters.

STRATEGY ADOPTED TO SOLVE THE PROBLEMS

- Formation of the Mumbai Railway Vikas Corporation (MRVC) to implement the railway projects in Mumbai with the World Bank assistance.
- Resettlement and Rehabilitation of 15,000 project affected households to get the encroached railway land vacated.
- Introduction of new traction technology at 25 KV AC converting from 15,00V DC system.
- Increasing the length of trains from 9 to 12 cars, thus creating 33 per cent extra carrying capacity.
- Introduction of rakes with new technology having IGBT-based traction control system with regenerative braking.

FUTURE OF MUMBAI SUBURBAN RAILWAY SYSTEM

The Birth of MRVC

To address the problem of deteriorating travelling conditions in the suburban railway system of Mumbai, the Government of Maharashtra and the Indian Railways came forward and the Mumbai Railway Vikas Corporation Ltd. (MRVC) was set up with the following main objectives:

- Bringing down the over-crowding in peak hour peak direction 9-car train from 5,000 to 3,000 passengers.
- Segregating the suburban train operation from the main line passenger and freight services.

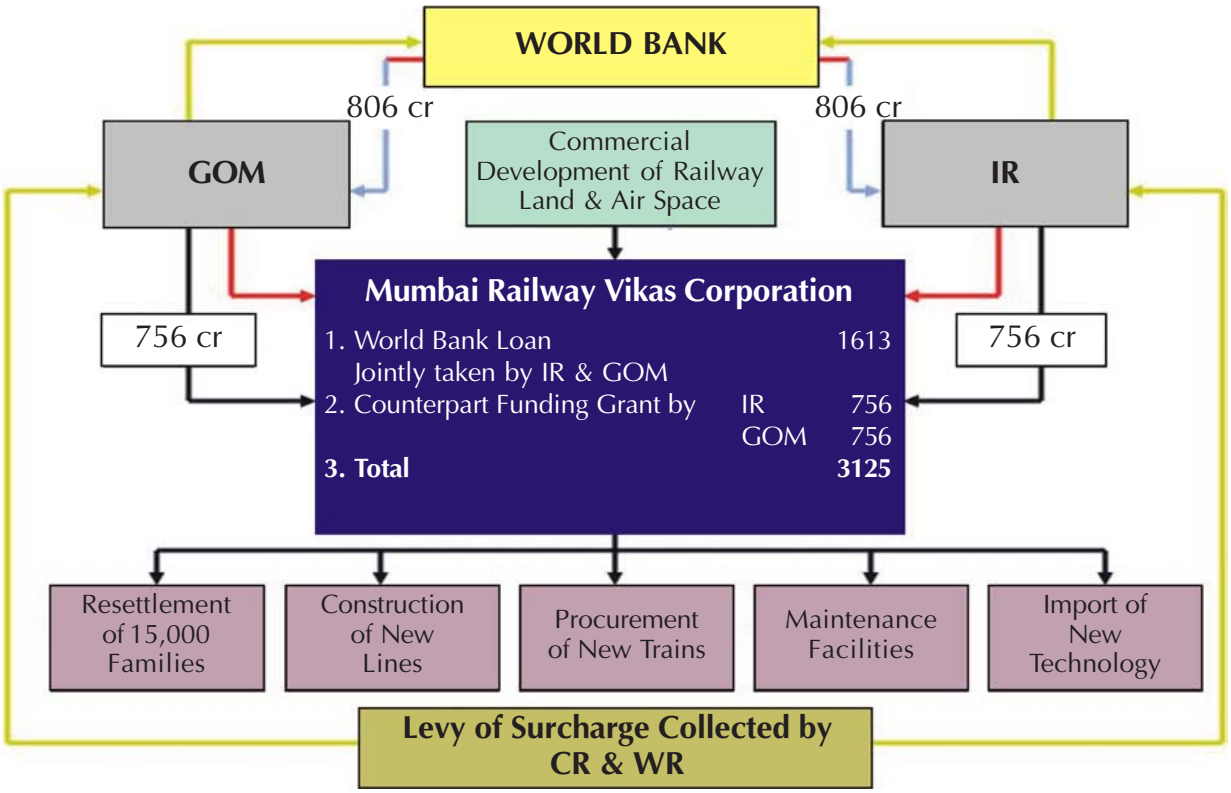
Infrastructure investment decisions for the provision of public transport should always be made or influenced by governments, especially where the market is restricted (regulated) to achieve specific public transport objectives (Andries, 2009). These objectives are guided by the government's policy frameworks such as four mobility provision (= social policy), relieving congestion through capacity (= transport policy), and partial replacement of private transport to manage externalities, land-use, modal integration, etc. (= planning policy).

Public-Public Participation

Traditionally, making provisions for infrastructure has been the responsibility of the government. In the recent past, a paradigm shift has begun with the government/public sector partnering with the private sector to promote infrastructure in the country. MRVC has given a different dimension to this public-private partnership and has evolved a model of public-public (Maharashtra government-Indian Railways) partnership (Figure 2) to finance the MUTP infrastructure project.

To achieve the above objectives, an investment of around Rs. 10,000 crore was needed. It was decided to undertake the capacity enhancement works in Mumbai in three

Figure 2: Public-Public Partnership to Finance Phase 1 of MUTP



phases. In Phase I, works worth Rs. 3,125 crore were identified and it was decided to take a loan of up to 50 per cent of the requirement from the World Bank. The loan would be repaid by a levy of surcharge in three stages on the existing passenger tickets. Apart from that, a non-refundable grant was to be given by the Government of Maharshtra and the Indian Railways. The following funding pattern was adopted:

Phase I included the following works:

New Line Works
- Borivali-Virar Quadrupling
- 5th & 6th Lines between Kurla-Thane
- 5th Line between Mahim-Santacruz
- Extension of EMU service up to Dahanu Road on Western Railway

Rolling Stock
- Procurement/Manufacture of EMUs

Capacity Enhancement Works
- DC to AC conversion in Mumbai suburban sections
- Optimization of existing corridors including facilities for running of 12-car trains

Resettlement and Rehabilitation
- Resettlement and rehabilitation of 15,000 project-affected households

RESETTLEMENT OF 15,000 PROJECT-AFFECTED HOUSEHOLDS

As already mentioned, the vacant surplus railway land in Mumbai was encroached upon. For getting this land free for implementing the railway projects, it was decided that each and every project-affected household will be given a house of 225 sq. ft. at different locations. 15,000 new flats have been constructed and all the project-affected households have been resettled. All the resettled people are happy; they are feeling socially upgraded with a substantially improved standard of living. MRVC has spent Rs. 400 crore to take care of the social obligations.

With the removal of encroachments, 3.2 lakh sq. mtrs. of encroached railway land both on the Central and Western Railways has been vacated. With the completion of this important task, the work of laying of additional tracks between Borivali and Virar was completed and the section was dedicated to the nation on July 7, 2007. For laying of additional tracks between Kurla and Thane, the work is in progress.

Mr Robert B. Zoellick, President, World Bank, during his visit to Mumbai, had inspected the resettlement sites and appreciated the efforts put in by the Railways and the Government of Maharashtra in rehabilitating the project-affected households. He mentioned about this important issue during his address in the concluding session of Sustainable Development Network (SDN) Workshop held in World Bank's HQ in Washington DC in February 2008.

UPGRADATION OF PASSENGER AMENITIES

Effective upgradation of a system enables the organizations to cope up with changes in the environment. The capacity and reliability (www.errac.org) of urban rail networks can be enhanced by the introduction of innovative high-capacity urban rail vehicles and the development of high-performance urban rail infrastructure supported by new signalling concepts.

In order to bring tangible improvements in the Electric Multiple Unit (EMU) trains, after getting feedback from the commuters, the following additional features have been added to improve the passenger amenities:

Improved Ventilation

ASHRAE standard has been adopted by restricting the CO_2 level inside the coaches to 700 ppm above the ambient CO_2 levels outside the coaches, the normal levels being 600-700 ppm. In each coach, 15,000 cu. m. of fresh air is being pumped in per hour. With this, the CO_2 level has come down from 2,500 ppm to 1,500 ppm (Figure3). In addition, larger windows are also provided to facilitate air circulation.

Improved Illumination

The lighting inside the coaches has been improved to 300 lux from the present 120 lux.

Improved Seats

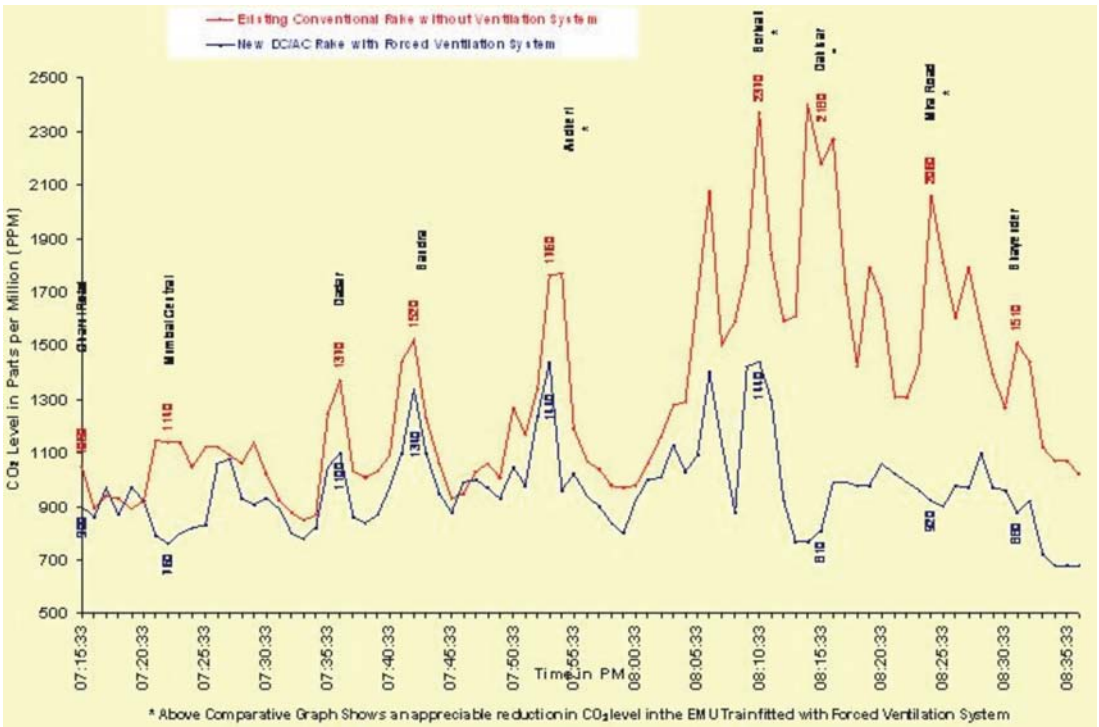
In place of wooden seats, polycarbonate seats have been provided in the general coaches and seats with PU cushion have been provided in the First Class.

Passenger Information System

Geographic Positioning System (GPS) based passenger information system has been provided in all the coaches with the following facilities:

- Automatic announcement of approaching stations in three languages, i.e. English, Hindi, and Marathi
- Platform indicator
- Emergency announcement
- LED-based head code.

Figure 3: Comparative CO2 Levels in SDCL EMU Train



Pneumatic Suspension

- Pneumatic suspension has been used to improve the riding index.

Interiors

To give an aesthetic look and improve strength, stainless steel partitions, grab handles, and FRP interior panels have been used inside the coaches.

Improved Colour Scheme

The National Institute of Design, Ahmedabad has designed the new exterior colour scheme using a combination of violet and white colour with red band has been finalized. The commuters have highly appreciated this new colour scheme.

All the above measures have been contributing to customer satisfaction. It may also help in attracting customers using private automobiles. As observed by APEIS, diversion of passengers (www.iges.or.jp) from private automobile use to public transport, and improvement in air quality, has been observed in many cases in the world. However, if the network is not developed well, effectiveness may get affected.

New EMU Trains for Mumbai Suburban System: Eco-friendly System

In the next three to four years, the Mumbai suburban system will get 173 nine-car rakes with passenger amenities. It is felt that with the provision of passenger-friendly improved features, overall upgradation of passenger amenities will take place. The most important feature of the new EMU trains which the public has liked the most is that the CO_2 level inside the coaches has been reduced by 44 per cent, from 2,500 ppm to 1,400 ppm during the peak period resulting in an eco-friendly system and an enhanced consumer satisfaction. The commuters have liked the initiatives taken by MRVC in improving the passenger amenity features on EMU trains. It was corroborated in the consumer feedback survey recently conducted by MRVC.

Energy Efficiency

In the existing 1,500V DC traction system, the voltage cannot be increased or decreased. The speed control of traction motors is through resistance control, i.e., voltage reduces or increases the resistance. During braking, the rotational energy of trains is wasted due to the friction generated between the brake blocks and wheels.

Since the suburban trains are expected to stop frequently, not only a lot of noise is produced during braking but at the same time iron/carbon dust is also generated. The brake blocks and wheels also have a limited life and require high maintenance inputs.

In the new design of EMU rakes, a 25,000V AC traction system is used. With the electronic equipments, 25,000V is converted into Variable Voltage Variable Frequency AC supply, which is then fed to the 3-phase induction motors fitted in the motor coaches. During braking, traction motors work as generators and 30 per cent of the electric energy is pumped back into the traction system due to the use of re-generative braking. It is estimated that with all the newly designed trains put into service, there will be energy saving of 20 crore units, which will enable a reduction in the production of CO_2 emission by 20 lakh tonnes in the power stations. This important feature has motivated MRVC to work hard to obtain carbon credits. The World Bank has already identified this project as Clean Development Mechanism project.

Apart from energy saving, with the use of step-less speed control and re-generative braking system, jerks are avoided and noise levels have been brought down from 80 db to 65 to 68 db.

Upgradation of Signaling System

With the introduction of 25,000 V AC traction system, in place of 1,500V DC traction system in the suburban section, Audio Frequency Track Circuits (AFTCs) and Digital Axle Counters (DACs) have been incorporated.

Increase in the Number of Coaches per Trains

To generate an additional carrying capacity, it has been decided to increase the number of coaches per train from nine to twelve on all the trains. This will be possible only when the present 1,500V DC traction system is changed over to 25,000V AC traction system. When the traction system is changed from DC to AC, the operating current per train will be reduced from 5,000 amps to 300 amps approximately. In other words, the number of traction substations in the Western and Central Railways will be reduced from the existing 66 to 22. This will also improve the voltage condition in the entire Mumbai suburban section and will enable us to increase the length of trains

from 9 to 12.

Noise Control

In the existing trains, a lot of noise gets generated on account of acceleration, braking, and working of compressors, etc. The present level of noise inside the coach is more than 85 db. With the introduction of a compressor of a modified design and IGBT step-less control with regenerative braking, the noise level inside the coach has been reduced to 65-68 db.

Afforestation

For laying of additional tracks between Borivali-Virar and Kurla-Thane, 3,500 mangroves were cut. MRVC has taken up the responsibility to upgrade the environment and planted 13,000 mangroves. The survivability of these trees is checked every six months by the World Bank team and the survivability rate of such mangroves is 80 per cent.

Cost Management: Reduction in Cost

The cost of MRVC (nine-car) rake is Rs. 20 crore approximately. The cost of a fully imported nine-car rake of similar features would be around Rs. 60 crore. The cost reduction has been achieved by adopting the following strategy:

- The equipments with improved features have been designed by M/s. Siemens, Germany. Out of the total quantity ordered, only 30 per cent of the equipments were manufactured abroad and the rest were to be manufactured in the facilities that were set up by M/s Siemens in India.
- An interest-free advance of Rs. 180 crore had been given to M/s Siemens, Germany and with this amount, factories at the following locations have been set up to manufacture the major components in India and the cost of equipment manufactured in India has been reduced by approximately 30 per cent (Table 3).
- Improved features of passenger amenity items were developed indigenously at the Integrated Coach Factory (ICF) with the features matching the international standards. This also led to cost reduction. By manufacturing the coach body and shell at ICF, which is the Indian Railway's manufacturing unit, the manufacturing cost has been kept low as no profit margins have been included in the cost. The cost of nine-car rake built by ICF is Rs. 20 crore approximately as against Rs. 60 crore of the imported rakes with similar features.

Apart from the above, in order to provide a reasonable and efficient transport system to Mumbai, the following further actions are being taken:

- Sanctioning of MUTP Phase II

MUTP Phase II has been sanctioned in the Railway Budget 2008-09. The list of works included in MUTP Phase II is given in Table 4.

Figure 4: MRVC Achieving Diverse and Multiple Objectives

Table 3: Comparative Costs and Cost Reduction

Sr. No.	Equipment	Location of Factory set up in India	Cost per Motor Coach		% Saving
			Imported Equipment	Indigenized Equipment	
1.	**Traction Motor**	**Kalva**	**Rs. 65.40 lakh**	**Rs. 51.36 lakh**	**21.47**
2.	Power Converter	Nashik	Rs. 96.14 lakh	Rs. 84.31 lakh	12.30
3.	Auxiliary Converter	Nashik	Rs. 32.87 lakh	Rs. 21.85 lakh	33.53
4.	Power Transformers	Vadodara	Rs. 30.12 lakh	Rs. 22.25 lakh	26.13

Source: MRVC EMU Contract Records.

Table 4: Outlays for MUTP Phase II

(Rs. in crore)

Sr. No.	Work	Cost at Current Prices (March 2008)
	NEW LINE WORKS	
1	5th & 6th Lines CSTM-Kurla	537
2	5th & 6th Lines Thane-Diva	115
3	6th Line Mumbai Central-Borivali	430
4	Extension of Harbour Line from Andheri to Goregaon	88
	ROLLING STOCK	
5	EMU Procurement & Manufacture	2,324
	CAPACITY ENHANCEMENT	
6	DC to AC Conversion	237
7	Maintenance Facilities for EMUs	167
8	Stabling Lines for EMUs	111
9	Technical Assistance & Institutional Strengthening	52
10	Station Improvement & Trespassing Control	111
	R&R	
11	Resettlement & Rehabilitation of Project Affected Households	109
	Grand Total	**4,281**

Source: Sanctioned Works by Railway Board (2009-10).

MUTP Phase II is to be completed in five years and the completion cost of the project is Rs. 5,300 crore, which has been sanctioned. The funding arrangement for MUTP Phase II is given in Table 5).

Table 5: MUTP Phase II Fund Arrangement

	(Rs. in crore)
Cost of MUTP Phase II project	5,300
Grant by GoM	1,545
Grant by MoR	1,545
Loan*	1,910
Revenue from commercial development**	**300**

* Loan to be repaid by continuation of Phase I surcharge.
** Depending upon FSI realized, equal financial relief to GoM and MoR will be available.

At the end of Phase II, the crowding in the suburban trains will further come down to around 3,000 passengers per 9-car train in the peak hour peak direction after meeting the additional requirements generated during the interim construction period. Some of the requirements included:

- Introduction of 15-car train in the suburban system to create additional capacity
- Introduction of cab signaling
- Elevation of track above the existing tracks for running of suburban trains in public-private-partnership mode.

The diverse but integrated objectives that were achieved holistically have been shown in Figure 5. It is indeed innovative strategic management that led MRVC to attain these diverse objectives, ranging from customer satisfaction, energy conservations, socio-economic benefits, to environmental upgradation through afforestation, rain water harvesting, and noise reduction.

FUTURE EXPANSION PLANS: MUTP PHASE III

The Mumbai Metropolitan Region Development Authority (MMRDA) was assigned the Comprehensive Transport Study for the Mumbai Metropolitan Region. The consultant has submitted the final report to MUTP. In this report, projects worth Rs. 30,000 crore have been identified to upgrade the existing suburban railway system on both Central and Western Railways. As a consequence, the following new lines and capacity augmentation works have been identified for implementation in future:

New Line Works

- New suburban corridor on Virar-Vasai-Diva-Panvel section
- 3rd and 4th Line Virar-Dahanu Road
- 5th and 6th Line Borivali-Virar
- Extension of Harbour Line from Goregaon to Borivali
- Provision of fast corridor on Harbour Line.

Capacity Augmentation Works

- Running of 12/15-coach trains on Harbour Line
- Introduction of 15-coach trains on Central and Western Railways mainline
- Implementation of Communication Based Train Control (CBTC) for achieving two minutes headway
- Station improvement and entry/dispersal arrangements at all the suburban stations.

Rolling Stock

- Procurement of additional rolling stock with door closing arrangement
- Maintenance facilities and stabling line for the rolling stock.

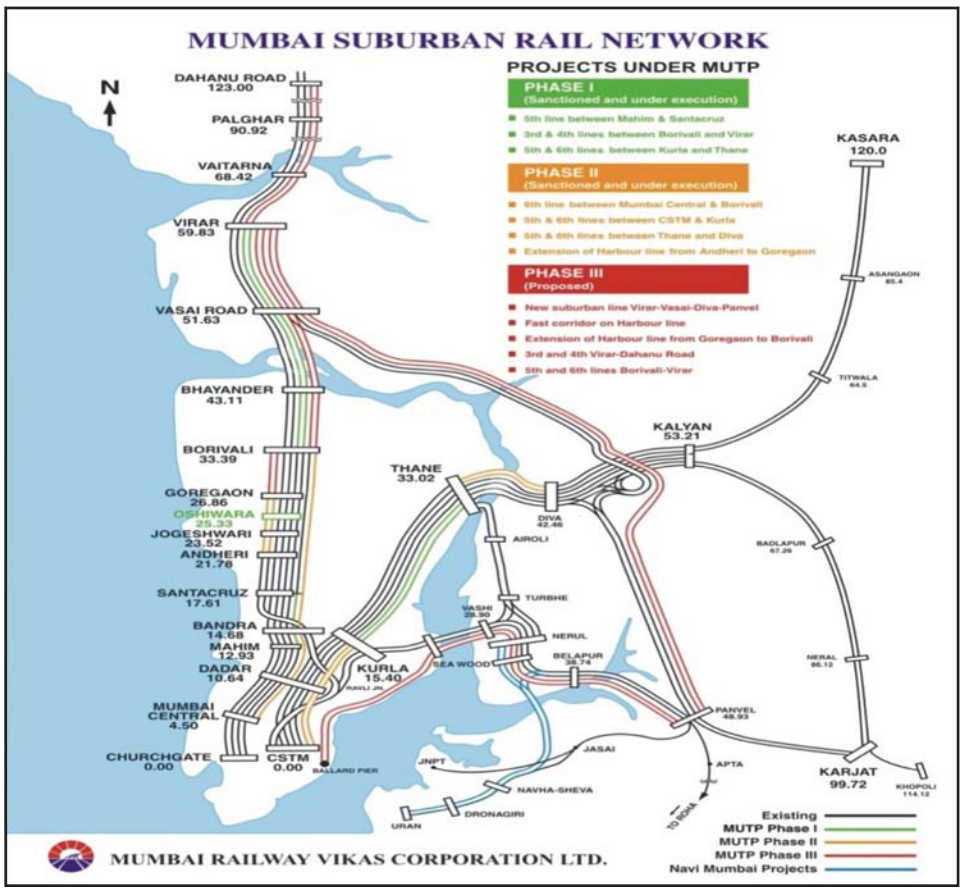
Once MUTP Phase I, Phase II, and Phase III works are completed, the overall suburban railway network will be upgraded. The details of the overall future suburban railway network is given in Figure 5:

CONCLUSIONS

From the above, it is quite clear that with the completion of works identified and undertaken by MRVC, the following tangible improvements could be seen in the suburban sections of Mumbai:

- Increased number of suburban trains for Mumbai commuters
- Social upgradation of 15,000 slum dwellers by resettling them in proper houses
- Upgradation of passenger amenities in suburban trains achieved by provision of ventilation system, GPS based passenger information system, pneumatic suspension for comfortable riding, etc.
- 30 per cent energy conservation is obtained through the introduction of regenerative electric braking in EMU trains thus enabling MRVC to obtain Carbon Credits.
- Significant reduction in the noise levels in the coaches by provision of low noise compressors and pneumatic

Figure 5: Future Suburban Rail Network



suspension, thus improving overall environmental conditions.

- Maintenance of ecological balance through MRVC's efforts towards rain water harvesting, mangrove plantation, tree plantation and transplantation to compensate for the cutting of tress at project sites. A glaring example of an infrastructure project that aptly envisaged ecological balance and environmental upgradation.

It is felt that when all the existing EMU rakes are replaced with the trains with new design, the safety and reliability standards of the existing system will improve. Social upgradation of 15,000 project-affected families, upgradation of amenities for passengers, environmental upgradation by saving energy up to 30 per cent, noise level reduction, and plantation of trees would additionally help in improving the suburban railway system.

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