

**Document of  
The World Bank**

Report No: ICR00004109

**IMPLEMENTATION COMPLETION AND RESULTS REPORT  
(IBRD-79410)**

ON A  
LOAN  
IN THE AMOUNT OF US\$ 430 MILLION  
TO THE  
GOVERNMENT OF INDIA  
FOR A  
MUMBAI URBAN TRANSPORT PROJECT – 2A

June 27, 2017

Transport and Information and Communications Technology (ICT) Global Practice  
South Asia Region

## CURRENCY EQUIVALENTS

(Exchange Rate Effective December 30, 2016)

Currency Unit=Indian Rupee (INR)

INR 67.95 = US\$ 1.00

US\$ 1.34 = SDR 1.00

## FISCAL YEAR

*April 1 – March 31*

## ABBREVIATIONS AND ACRONYMS

AC	Alternating Current	IR	Indian Railways
CR	Central Railways	KM	Kilometer
DC	Direct Current	KV	Kilovolt
DEA	Department of Economic Affairs	M&E	Monitoring and Evaluation
EMP	Environmental Management Plan	M&P	Mechanical and Plant
EMU	Electric Multiple Unit	MMR	Mumbai Metropolitan Region
FOB	Foot Over-Bridges	MMRDA	Mumbai Metropolitan Regional Development Authority
GCC	General Conditions of Contract	MRVC	Mumbai Railway Vikas Corporation
GDP	Gross Domestic Product	MTR	Mid-term Review
GoI	Government of India	MUTP	Mumbai Urban Transport Project
GoM	Government of Maharashtra	PAD	Project Appraisal Document
IBRD	International Bank for Reconstruction and Development	PDO	Project Development Objectives
ICF	Integrated Coach Factory	RDSO	Research Design and Standards Organization
ICR	Implementation Completion and Results Report	R&R	Resettlement and Rehabilitation
ICT	Information and Communications Technology	SDR	Special Drawing Rights
ID	Institutional Development	USD\$	United States Dollars
INR	Indian Rupee	WR	Western Railways

Senior Global Practice Director: Jose Luis Irigoyen

Sector Manager: Karla Gonzales Carvajal

Project Team Leader: Atul Agarwal

ICR Team Leader: Dominic Patella

**INDIA**  
**Mumbai Urban Transport Project – 2A**

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**Map (IBRD 37317)**



<b>A. Basic Information</b>			
Country:	India	Project Name:	Mumbai Urban Transport Project-2A
Project ID:	P113028	L/C/TF Number(s):	IBRD-79410
ICR Date:	06/27/2017	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	GOVERNMENT OF INDIA
Original Total Commitment:	USD 430.00M	Disbursed Amount:	USD 280.10M
Revised Amount:	USD 309.00M		
Environmental Category: B			
Implementing Agencies: MRVC			
Cofinanciers and Other External Partners:			

<b>B. Key Dates</b>				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	05/14/2009	Effectiveness:	10/21/2010	10/08/2010
Appraisal:	02/08/2010	Restructuring(s):		08/11/2011 05/08/2013 10/09/2014 03/07/2016
Approval:	06/29/2010	Mid-term Review:	06/17/2013	06/17/2013
		Closing:	06/15/2015	12/31/2016

<b>C. Ratings Summary</b>	
<b>C.1 Performance Rating by ICR</b>	
Outcomes:	Moderately Satisfactory
Risk to Development Outcome:	Moderate
Bank Performance:	Moderately Satisfactory
Borrower Performance:	Satisfactory

<b>C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)</b>			
Bank	Ratings	Borrower	Ratings
Quality at Entry:	Moderately Satisfactory	Government:	Satisfactory
Quality of Supervision:	Moderately Satisfactory	Implementing Agency/Agencies:	Satisfactory
Overall Bank Performance:	Moderately Satisfactory	Overall Borrower Performance:	Satisfactory

<b>C.3 Quality at Entry and Implementation Performance Indicators</b>			
<b>Implementation Performance</b>	<b>Indicators</b>	<b>QAG Assessments (if any)</b>	<b>Rating</b>
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	Yes	Quality of Supervision (QSA):	None
DO rating before Closing/Inactive status:	Satisfactory		

<b>D. Sector and Theme Codes</b>			
		<b>Original</b>	<b>Actual</b>
Major Sector/Sector			
Transportation			
Railways		97	97
Public Administration – Transportation		3	3
Major Theme/Theme/Sub Theme			
Urban and Rural Development			
Urban Development		100	100
Urban Infrastructure and Service Delivery		100	100

<b>E. Bank Staff</b>		
<b>Positions</b>	<b>At ICR</b>	<b>At Approval</b>
Vice President:	Anette Dixon	Isabel M. Guerrero
Country Director:	Junaid Kamal Ahmad	N. Roberto Zagha
Practice Manager/Manager:	Karla Gonzalez Caravajal	Michel Audige
Project Team Leader:	Atul Agarwal	Hubert Nove-Josserand
ICR Team Leader:	Dominic Patella	--
ICR Primary Author:	Paul Kaiser	--

## F. Results Framework Analysis

### ***Project Development Objectives (from Project Appraisal Document)***

*To improve the passenger carrying capacity, operational efficiency, level of comfort of, and the institutional capacity of entities involved in the suburban rail system of Mumbai Metropolitan area.*

### ***Revised Project Development Objectives (as approved by original approving authority)***

Unchanged.

#### **(a) PDO Indicator(s)**

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Vehicle km per day during morning peak hours (8-11 a.m.) – Western Railway, Central Railway/ML, Central Railway/Harbour</b>				
Value	561,461 (WR) 447,578 (CR/ML) 151,001 (CR/H)	815,400 (WR) 770,050 (CR/ML) 182,646 (CR/H)	n/a	560,265 (WR) 550,464 (CR/ML) 303,105 (CR/H)
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
<b>Comments</b>				
Targets, as expressed in PAD for WR and CR (ML) not achieved. Target for CR-Harbor Line exceeded.				
During implementation, the Project and the Team observed two errors in how this indicator was defined in the PAD, including: (i) an incorrect definition of “vehicle km per day during morning peak hours” when the baseline values corresponded to “vehicle km per day”; and (ii) the baseline value for CR Main Line (CR/ML) was incorrectly reflected in the PAD. Rather than 561,461 vehicle km per day, the correct baseline should have been 436,500 vehicle km per day. The Bank’s Team and the Project agreed to measuring the indicator as if it was defined as “vehicle km per day” (i.e. not just peak hours) and to consider 436,500 as the baseline indicator value for CR Main Line. However, neither the formal indicator definition nor the baseline value for CR Main Line was officially revised in any of the Project’s restructurings.				
<i>Data Source: MRVC analysis of data from CR and WR</i>				

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Reduction in overcrowding (passengers per 12-car train) – Western Railway, Central Railway, Harbour</b>				
Value	5,400 (WR) 4,800 (CR) 4,200 (Harbour)	4,000 (WR, CR, Harbour)	n/a	5,257 (WR) 4,340 (CR) 3,924 (Harbour)
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
<i>Comments</i>				
Targets for WR and CR not achieved. Target for Harbor line exceeded. <i>Data Source: MRVC analysis of data from CR and WR</i>				
<b>Action plan on revenue improvement prepared</b>				
Value	Plan not prepared	Completed and Action plan prepared	n/a	Action plan prepared
Date	1-Apr-09	31-Dec-12	n/a	31-Dec-16
<i>Comments</i>				
Target achieved. <i>Data Source: MRVC</i>				
<b>Action plan on trespassing and safety prepared</b>				
Value	Plan not prepared	Action plan prepared	n/a	Action plan prepared
Date	1-Apr-09	31-Dec-12	n/a	31-Dec-16
<i>Comments</i>				
Target achieved. <i>Data Source: MRVC</i>				
<b>Average energy consumption per 12-car train-km (kWh/t/km)</b>				
Value	17.62	12.76	n/a	12.48
Date	1-Apr-09	31-Dec-12	n/a	31-Dec-16
<i>Comments</i>				
The target has been exceeded (106% of targeted energy savings achieved). <i>Data Source: MRVC</i>				

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Reduction in journey times # transit times in minutes reduced for:</b> <b>Harbor Local from CSTM to Panvel;</b> <b>CR Local from CSTM to Thane and Kaylan;</b> <b>WR Local from Churchgate to Borivali and Virar</b>				
Value				
77 (Panvel) 56 (Thane) 59 (Kaylan) 65 (Borivali) 81 (Virar)				
75 (Panvel) 53 (Thane) 54 (Kaylan) 62 (Borivali) 75 (Virar)				
n/a				
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Targets not achieved.				
<i>Data Source: WR and CR timetables</i>				

**(b) Intermediate Outcome Indicator(s)**

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Impact assessment of trespassing reduction measures completed</b>				
Value				
Not prepared				
Study completed				
n/a				
Study to be completed in June 2017				
Date	1-Jan-13	15-Jun-15	n/a	31-Dec-16
Comments				
Target partially achieved as study was ongoing at the time of close. This study has subsequently been completed after Project close.				
<i>Data Source: MRVC</i>				
<b>Ridership per day Western Railway (WR) and Central Railway (CR)</b>				
Value				
3,298 (WR) 3,592 (CR)				
3,486 (WR) 3,797 (CR)				
n/a				
3,498 (WR) 4,027 (CR)				
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Targets achieved for WR and CR.				
<i>Data Source: MRVC analysis of data from CR and WR</i>				

<b>Continued MRVC ISO Certification</b>				
Value	MRVC Certified	ISO 14001 and ISO 18001 Certification	n/a	ISO 14001 and ISO 18001 Certification
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Target achieved. <i>Data Source: MRVC</i>				
<b>TA for IR strategy</b>				
Value	Not prepared	TA Completed	n/a	TA Completed
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Target achieved. <i>Data Source: MRVC</i>				
<b>Study on Mumbai suburban development plan</b>				
Value	Not prepared	Study completed	n/a	Study completed
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Target achieved. <i>Data Source: MRVC</i>				
<b>Study on potential for ISO 14001 at CR and WR</b>				
Value	Not done	Study completed	n/a	Study completed
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Target achieved. <i>Data Source: MRVC</i>				
<b>Additional track (TKM)</b>				
Value	0	181	n/a	93
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Target partially achieved (51%). <i>Data Source: MRVC</i>				

<b>Punctuality - percentage of trains reaching less than 5 minutes late to destination Western Railway (WR) and Central Railway (CR)</b>				
Value	98.2 (WR) 93.2 (CR)	98.5 (WR) 94 (CR)	n/a	96.67 (WR) 84.3 (CR)
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Target not achieved. It is also likely that the baseline value and subsequent measurement of this indicator may have suffered from data quality related deficiencies based on MRVC's assessment and the ICR team's comparison to international benchmarks which suggest that the 98.2% baseline reliability figure for WR may not have been accurate at the time of appraisal.				
<i>Data Source: MRVC analysis of data from CR and WR</i>				
<b>Length of trains (percent of 12 car trains) Corridor: CR Local, CR Through, WR Local, WR Through</b>				
Value	56 (CR Local) 61 (CR Through) 57 (WR Local) 71 (WR Through)	100 (CR Local, Through) (WR Local, Through)	n/a	100 (CR Local, Through) (WR Local, Through)
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Target achieved.				
<i>Data Source: MRVC analysis of data from CR and WR</i>				
<b>Trains per hour during peak hour Central Local, Central Through, Western Local, Western Through, Harbour Local</b>				
Value	14.4 (CR Local) 14.4 (CR Through) 17 (WR Local) 16 (WR Through) 16.4 (Harbour Local)	18 (CR Local, CR Through, WR Local, WR Through, Harbour Local)	n/a	15.66 (CR Local) 18 (CR Through, WR Local, WR Through) (Harbour Local)
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
The following targets were fully achieved: (i) CR though trains, WR local trains, and WR through trains;				
The following targets not achieved: (i) only 17% of target increase achieved for CR local; (ii)only 5% of target increase achieved for Harbor Line local trains.				
<i>Data Source: MRVC analysis of data from CR and WR</i>				

<b>DC to AC conversion (Track km)</b>				
Value	569	1,577	n/a	1,577
Date	1-Apr-09	15-Jun-15	n/a	31-Dec-16
Comments				
Target achieved. <i>Data Source: MRVC</i>				
<b>EMU Fleet size (12-car rakes in service)</b>				
Value	190	258	n/a	253
Date	1-Apr-09	15-Jun-15	n/a	28-Feb-16
Comments				
Target partially achieved (93% of feet increase achieved by project close). Target fully achieved (100% of fleet increase) at the time of ICR drafting. <i>Data Source: MRVC</i>				

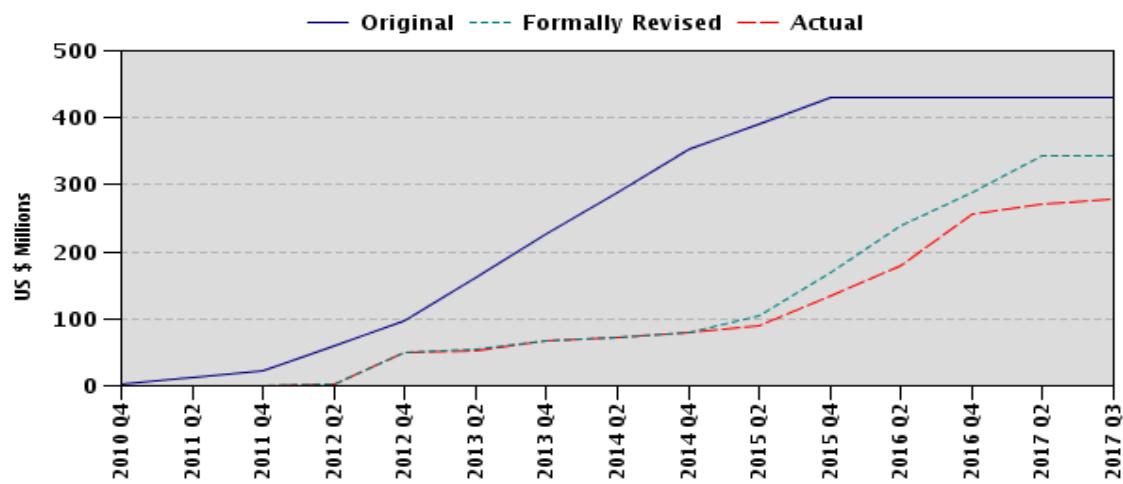
## G. Ratings of Project Performance in ISRs

No.	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
1	12/15/2010	Satisfactory	Satisfactory	0.00
2	06/30/2011	Satisfactory	Satisfactory	0.43
3	12/21/2011	Satisfactory	Moderately Satisfactory	1.78
4	04/14/2012	Satisfactory	Moderately Satisfactory	49.81
5	09/29/2012	Satisfactory	Moderately Satisfactory	53.26
6	03/31/2013	Satisfactory	Moderately Unsatisfactory	62.66
7	09/16/2013	Moderately Satisfactory	Moderately Unsatisfactory	68.10
8	12/01/2013	Moderately Satisfactory	Moderately Unsatisfactory	68.10
9	06/01/2014	Moderately Satisfactory	Moderately Unsatisfactory	78.74
10	08/15/2014	Moderately Satisfactory	Moderately Satisfactory	80.02
11	11/22/2014	Moderately Satisfactory	Moderately Satisfactory	89.53
12	04/23/2015	Moderately Satisfactory	Moderately Satisfactory	118.08
13	09/23/2015	Moderately Satisfactory	Moderately Satisfactory	145.81
14	03/29/2016	Satisfactory	Satisfactory	221.73
15	10/28/2016	Satisfactory	Satisfactory	269.07
16	12/29/2016	Satisfactory	Satisfactory	270.60

## H. Restructuring (if any)

Restructuring Date(s)	Board Approved PDO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		DO	IP		
08/09/2011		S	S	0.43	Transfer procurement contract of high speed bogies from MUTP-1 to MUTP-2A
05/08/2013		S	MU	62.66	Cancel \$45 million, and reallocate \$30 million for Component 4 trespassing activities
10/09/2014		MS	MS	83.97	Extend project closing date from 06/15/2015 to 12/31/2016. Cancelation of US\$ 41 million.
03/07/2016		S	S	213.41	Cancel \$35 million due to change in USD/INR exchange rate

## I. Disbursement Profile





## **1. Project Context, Development Objectives and Design**

### **1.1 Context at Appraisal**

#### ***Country Background***

1. At the time of appraisal in 2010, India's Gross Domestic Product (GDP) was growing at 8 percent per year, peaking at 9.7 percent in 2006-07. Many Indians were migrating to cities and towns in search of employment and an improved quality of life. It was estimated that by 2030 over 40 percent of India's population would be living in cities and towns, representing an increase from 28 percent in 2010. Urbanization was recognized as an important driver of economic growth, with cities contributing to 55 percent of the India's 2010 GDP. To sustain the impact of growing populations in urban centers, authorities at all levels of government in India recognized the importance of improving transportation.

2. This was especially the case for the Mumbai Metropolitan Region (MMR), which had a population of nearly eighteen million people in 2001. This was the sixth largest urban agglomeration in the world. The MMR was and continues to be the financial and commercial capital of India with the largest GDP of any Indian city. The coastal urban center represented forty percent of the total Maharashtra GDP, 33 percent of India's tax collections, 60 percent of its customs duty collections, 40 percent of port trade, 60 percent of stock exchange trading, and 30 percent of India's exports and imports. The criticality of infrastructure for Mumbai's continued success and growth was evident and remains so today.

#### ***Sector Background***

3. Mumbai's local and regional transport systems have been particularly affected by urbanization. The backbone of all urban transport in Mumbai is the suburban rail network which is managed by India Railways (IR). From 1951-2008, the rail network was lengthened by only eighteen percent (in route-kilometers), while the number of passengers tripled. The number of passenger-km grew eighteen-fold from 1951-2008 overall. Between 1991-2008 passenger-km on the suburban rail network doubled. This demand increase did not coincide with a proportional increase in the investment to improve services.

4. At the time of appraisal, the MMR had an extensive rail and bus system. Public transport was the mode for three out of every four motorized trips in the MMR with the clear majority of these trips involving suburban rail services. Two Indian Railways zonal railways, Western Railways (WR) and Central Railways (CR) operated this system and continue to operate it presently. The Mumbai Railway Vikas Corporation (MRVC) was established in 1999 as a joint IR and GOM undertaking (51%;49% respectively) to implement a program of capital investment and enhancement on the suburban network. This coincided with the Bank-supported MUTP-1 project. Importantly, MRVC does not operate railway services but manages portion of capital investment on the suburban railway. The zonal railways also undertake parallel capital investment. These roles require extremely close coordination between MRVC, CR, and WR to implement works in a way that minimizes disruption to services. The intensity of demand on the suburban railway's infrastructure makes this a particularly formidable challenge.

5. In 2007-08, an estimated 6.8 million passengers traveled on the suburban rail system every day (2.5 billion trips annually). Crowding was extreme with approximately 5,000 passengers traveling in a nine-car train with a rated carrying capacity of 1,700 passengers. Due in part to this overcrowding, coaches did not close doors and this resulted in passengers dangling outside of moving trains. This practice, along with trespassing on railway lines and the presence of informal settlements on or near active train tracks, were major causes of injuries and fatalities. The magnitude of accidental deaths and injuries on Mumbai's suburban network remains significant despite recent trends in improving safety which have benefitted from the project's support. For example, in 2016 there were 3,206 documented accidental deaths and 3,263 documented injuries that did not result in fatalities on the suburban rail system. Reducing these figures further remains a key technical, behavioral, and institutional challenge for the MMR.

6. At appraisal, a parallel capital investment initiative known as the Mumbai Urban Transport Project 2B (MUTP-2B) had been sanctioned concurrently for delivery alongside the Bank-supported MUTP 2A by the Government of India (GoI) and the Government of Maharashtra in fiscal year 2008-2009. These projects were collectively comprised within a single MUTP 2 project umbrella that was expected to cost INR 53 billion (US\$ 1.13 billion at the time of Appraisal). MUTP 2B was entirely government funded and implemented with 50% of funds from IR and 50% from GOM. Its various components were to be implemented by CR, WR, MRVC, and MMRDA. A key aim of MUTP 2B was to further expand the suburban rail system by developing additional parallel track. Specifically, this included (i) a sixth line between Mumbai Central and Borivali to help relieve the Western Railway portion of the network; (ii) extension of the Harbor Line to Goregaon which was also to augment capacity on the Western Railway section of the network; and (iii) a 5<sup>th</sup> and 6<sup>th</sup> line from Mumbai CST to Kurla which would augment capacity on the Central Railway portion of the network. MUTP 2B works started implementation while MUTP 2A was under implementation but had yet to reach completion by the close of the project. Two factors may have been the keen contributors to this delay, including:

- (i) Fiscal constraints and increasing costs - in 2013 the envisaged cost of MUTP 2B was to be INR 18.7 billion (US 278 million at the time). As of 2016, the cost estimate for MUTP 2B had increased to INR 32.8 billion (US\$ 561 million); and
- (ii) Additional complexities of land acquisition and resettlement which have delayed MUTP 2B's execution.

7. Importantly, additional track kilometers planned for MUTP-2B would allow for segregation of suburban rail traffic from through-trains that serve regional destinations. This was to have a critical impact on results envisaged from MUTP 2A primarily because separating suburban traffic from through trains would enable the suburban trains to operate at tighter headways between trains. Headways follow a "least common denominator" principle where the slowest train on the network limits the performance potential of all other trains due to spacing requirements for safety (i.e. to ensure that trains do not collide). As the suburban system's rolling stock and signaling systems advance, their performance potential becomes increasingly dissimilar to the performance of through trains which are not designed for high frequency stopping services. MUTP 2B's delay essentially held the entire system

back by leaving through trains on the suburban network where they are now a limiting factor to improving performance.

#### **Rationale for Bank Assistance**

8. The MUTP-2A aimed at supporting MMR's *TranSforM* vision of "transforming Mumbai into a world class metropolis with a vibrant economy and globally comparable quality of life for its citizens" and IR's *Vision 2020* goals of removing bottlenecks, augmenting capacity to match growing transportation demand, and providing comfort and convenience for its passengers. In addition, three of the Bank's strategic priorities in *The World Bank Country Strategy (2009-12)* informed MUTP-2A: rapid and inclusive growth; sustainable development; and improving government effectiveness in delivering services.

9. MUTP-2A followed on the successes of the Bank-supported MUTP-1 project which included: (i) Improvement of the capacity and performance of the suburban rail system; (ii) Increased in the capacity, efficiency, and safety of Mumbai's road network, better facilities for pedestrians, improved bus service, reductions in motor vehicle emissions levels, and enhanced capacity of responsible agencies to plan, deliver, maintain and operate efficiently road-based urban transport infrastructure and services; and (iii) GoM efforts to resettle those affected by investments under the rail and road-based transport components.

#### **1.2 Original Project Development Objectives (PDO) and Key Indicators**

10. The original PDO was *to improve the passenger carrying capacity, operational efficiency, level of comfort of, and the institutional capacity of entities involved in, the suburban rail system of the Mumbai Metropolitan area*. The achievement of the PDO was to be measured by the following PDO Outcome Indicators:

- (i) Additional capacity (vehicle km per day during morning peak hours from 8:30-11:30am);
- (ii) Reduction in peak hour overcrowding (average number of passengers per twelve-car train);
- (iii) Reduction in journey times (average transit times in minutes);
- (iv) Reduction in energy conservation (average energy consumption per twelve-car train - kWh/t/km);
- (v) Preparation of action plan on trespassing and safety; and
- (vi) Preparation of action plan on revenue improvement.

#### **1.3 Revised PDO Key Indicators, and reasons/justification**

11. PDO Outcome Indicators were not revised. One Intermediate Outcome Indicator was added in the May 2013 restructuring to monitor the addition of twelve trespassing control works based on the trespassing and safety action plan that was an original PDO Outcome Indicator target. Given the minimal changes to the indicators, the ICR Team did not opt for a split evaluation.

#### **1.4 Main Beneficiaries**

12. The main beneficiaries of this project included: (i) WR and CR passengers (including low-income and middle-income commuters); (ii) The Implementing Agency (Mumbai Railway Vikas Corporation, MRVC); (ii) Executing agencies (Mumbai Metropolitan

Regional Development Authority, or MMRDA), Integral Coach Factory (ICF), Research Designs and Standards Organization (RDSO), WR and CR; (iii) Faculty, staff and students from the Sir J.J. College of Architecture at the University of Mumbai that developed the trespassing and safety action plan; and (iv) Passengers and community members using the twelve CR and WR train stations that benefitted from trespassing prevention works and, more broadly.

## **1.5 Original Components**

13. MUTP-2A had four components. The first three focused on additional train services for Mumbai's suburban rail network. The fourth technical assistance component strengthened the institutional and managerial capacity of MRVC and IR. The four components built on MUTP-1, which supported overall improvements in the capacity and performance of the suburban rail system.

### ***Component 1 – Electric Multiple Unit (EMU) rolling stock increase***

*(IBRD loan US\$ 355.7 million; Client funding USD\$ 303.9 million)*

14. Component 1 supported the procurement of 864 additional EMU cars (72 twelve-car rakes), increasing the total fleet to around 3,124 cars. The Bank loan financed the electrical equipment for the new cars manufactured at the Chennai ICF, with Client funding for the remaining costs of production. The cars were designed and built for use on a 25 Kilovolt (kV) Alternating Current (AC) system.

### ***Component 2 – Conversion of power supply from Direct Current (DC) to AC (including improvements to signals and telecoms)***

*(IBRD loan USD\$ 55.2 million; Client funding USD\$ 118.6 million)*

15. Component 2 supported the conversion from 1,500V DC traction to 25kV AC in three sections of the MMR's CR. This included: modifying overhead catenaries; installing power sub-stations, along with switching stations; procuring catenary maintenance equipment; and modifying signal and telecom systems (required to allow for the operation of the new EMU cars procured under Component 1).

### ***Component 3 –EMU maintenance and stabling lines***

*(IBRD loan US\$ 0; Client funding US\$ 117.7 million)*

16. The capacity of five existing EMU maintenance sheds, two periodic overhaul workshops, and the Virar shed supported by MUTP-1, were upgraded. In addition, 73 new stabling lines were financed to accommodate additional trains supplied under Component 1 of the project: 39 at Kurla on the CR and 34 at Virar on the WR (including four extensions from nine-car to twelve-car). Component 3 was fully funded by Government.

### ***Component 4 – Capacity strengthening and technical assistance***

*(IBRD loan US\$ 14.4 million; Client funding US\$ 0.2 million)*

17. Strategic and tactical studies, as well as capacity building and training, were initially supported by the project. Strategic studies focused on: (i) developing a priority program for the Mumbai suburban rail services consistent with the *TransforM* study (including

feasibility studies); (ii) long-term strategic planning for IR to implement Vision 2020 (for the suburban rail services); and (iii) analyzing the financial situation of the Mumbai suburban rail operation by maximizing non-farebox revenues.

18. The following four studies were also supported by the project: (i) developing an enhanced ticketing system for the Mumbai suburban rail service; (ii) improving the passenger information system; (iii) reducing accidents due to trespassing; and (iv) strengthening environmental practices in CR and WR operations.

19. Capacity-building focused on the supply and installation of software for improved power supply and operation simulation, and training (including study tours) to reinforce professional efficiency of MRVC officers based on approved training plan.

## **1.6 Revised Components**

20. Based on the May 8, 2013 restructuring described in detail below, US\$ 30 million was reallocated to Component 4 to implement passenger safety related measures and for trespassing control measures at select suburban rail stations. This additional activity was based on findings from the trespassing and safety action plan funded by the project.

## **1.7 Other Significant Changes**

21. The following Level Two restructurings were implemented:

22. *August 9, 2011, Report No. 63374-IN:* Transfer the contract of procurement of high speed bogies from MUTP-1 to MUTP-2A. There was no change in PDO, institutional, implementation and disbursement arrangements, and financial planning. No additional safeguard policies were triggered based on this restructuring and no additional financing was required.

23. *May 8, 2013, Report No. 77376-IN:* US\$ 45 million cancelled and US\$ 30 million reallocated to implement recommendations of the trespassing and safety action plan for safety-related measures and for preventing trespassing under project Component 4. There was no change in PDO, institutional, implementation and disbursement arrangements, and financial planning. No additional safeguard policies were triggered based on this restructuring, but the Client developed an Environmental Management Plan (EMP) for the planned trespassing works.

24. *October 9, 2014, Report No. 13216:* US\$ 41 million canceled due to savings from currency depreciation and change in project closing date from June 15, 2015 to December 31, 2016 to complete all project components, especially the supply of EMUs and the completion of trespassing control works.

25. *March 7, 2016, Report No. 22792:* Cancellation of US\$ 35 million due to savings linked to the change in USD/INR exchange rate.

26. Four months after project close, there was an undisbursed balance of US\$ 28.9 million which was canceled when loan IBRD-79410 reached its end of disbursement date.

27. Despite the deficiencies with the PDO Outcome and Intermediate Outcome indicators identified in this ICR, no indicators were revised, with only one added to reflect the additional activities associated with the May 8, 2013 restructuring. In part, this reflected the Team's struggle during implementation to quantify the portion results attributable to project interventions. An alternative, and perhaps more appropriate option, could have entailed a fundamental redesign of indicators (i.e. not only a change in target values) to address attribution issues.

## **2. Key Factors Affecting Implementation and Outcomes**

### **2.1 Project Preparation, Design and Quality at Entry**

28. Project preparation, design and quality at entry were impacted by the Client and the Bank's desire to integrate lessons learned from MUTP-1, while continuing to build MRVC's capacity to successfully implement MUTP-2A. The following factors affected how the new project was prepared and designed, and its quality at entry:

29. *MRVC demonstrated capacity and ability to tackle incremental strategic level issues:* MUTP-1 demonstrated MRVC's capabilities as an implementing institution and prepared a foundation for broaching incremental issues relating to the suburban system's long term sustainability. The design of MUTP-2A therefore included support for strategic and tactical studies, training, and data-driven simulation exercises so that MRVC could continue to develop its knowledge-base and capacity throughout implementation with a view to playing an active role in shaping the suburban rail system's future.

30. *Focus on forward looking needs and planning:* MUTP-2A prioritized long-term planning and accordingly focused project support on the provision of new rolling stock to address expected increase in demand for rail services in the MMR. In addition, the project supported the construction of an additional maintenance shed in Virar to support a long-term, multi-phased enhancement of maintenance capacity based on projections of increased rolling-stock. While MUTP-1 supported the establishment of the Virar facility and the construction of one maintenance shed, MUTP-2A supported the construction of a second shed to meet increasing demands of existing and new rolling stock.

31. *Inter-agency cooperation:* MUTP-2A recognized the importance of inter-agency coordination to effective and timely project implementation. One of the key reasons for the slow pace of implementation in MUTP-1 was the complex project design characterized by ambitious implementation arrangements involving multiple implementing agencies without effective coordination. MUTP-2A's implementation structure was therefore streamlined based on this experience, with MRVC serving as the implementing agency empowered to coordinate with the main IR executing agencies. An important factor to consider in evaluating project implementation is that while MRVC served as the implementer of capital investment, it is not responsible for operating services. This was known at the time of MUTP 2A's preparation but the associated risks may not have been fully assessed and reflected – particularly in the project's monitoring and evaluation framework.

32. *Complexity of implementation context and the experience of MUTP 1:* MUTP-2A's design appeared to recognize the challenges of inter-agency coordination issues described above, along with the management of necessary land acquisition along with resettlement

and rehabilitation (R&R) issues, which were roadblocks to the timely implementation of MUTP-1 activities also affected the Bank's relationship with GOM. In contrast to the resettlement of approximately 19,000 project affected households in MUTP-1, MUTP-2A did not involve the resettlement of project affected households, and all project works were completed on land in the rail corridors owned by IR.

33. *Use of data:* MUTP-2A utilized relevant data and simulation information when determining the number of rakes to be financed by the project. The initial project design for MUTP-2A originally included the procurement of sixty twelve-car rakes. MRVC conducted data-driven simulation exercises that demonstrated that the rail system could effectively sustain a total of 72 twelve-car rakes by the end of MUTP-2A, so the decision was made to finance the additional twelve rakes to further enhance the system's capacity. Additional analyses are currently underway for MUTP-3 regarding potential enhancements to the signaling system on Mumbai's suburban rail network that could further increase trains per hour and overall system capacity.

34. *Indicator selection:* MUTP-2A identified multiple indicators to monitor and evaluate progress made in improving passenger carrying capacity, operational efficiency, level of comfort, and institutional capacity. However, several key indicators measured results over which the project did not have control. Foremost among external impacts on results were: (i) uncertainty over the delivery of complementary projects such as MUTP 2B and other counterpart initiatives; (ii) construction disruptions to railway operations; (iii) operational constraints such as turn-back capacity; and (iv) knock-on effects from a multitude of external factors that affect the suburban systems ability to supply services as well as the demand for those services. The project's M&E framework was complicated, with many indicators, yet overly simplistic in its design of those indicators. Specifically, the indicators relating to capacity, comfort, and efficiency captured very little that was directly attributable to the project interventions except for the indicator relating to energy efficiency. This was a key shortcoming in MUTP 2A's design and quality at entry.

## 2.2 Implementation

35. Each of MUTP-2A's four project components had specific factors that affected overall project implementation, often affecting timeline progress and results achieved. These factors are described below, broken down by component.

### ***Component 1 – Electric Multiple Unit (EMU) rolling stock increase:***

36. At the time of MTR in June/July 2013 (36 months into implementation), the delivery of EMUs was delayed by six months, with indications that this delay could be as much as eleven months. This was due to earlier slippages in design approvals by RDSO which were in turn related to an issue of platform clearances relating to MUTP-2A rolling stock which had a different configuration than prior designs. The underlying technical issue concerned a regulatory minimum clearance between trains and platforms that was affected by the rolling stock design used for MUTP 2A. Importantly, the interface risk that MUTP 2A encountered is common in situations where existing systems endeavor to integrate new rolling stock designs with legacy station platforms. A key lesson from international experience is that there is a fundamental difference between buying additional rolling stock of a traditional design and developing new rolling stock configurations that must work with an existing

railway system. The Bank and MRVC proactively worked together to address the delays that MUTP-2A encountered, working closely with RDSO, ICF and IR to obtain the needed approvals and expedite production and delivery processes. From July to December 2015, sixteen rakes were delivered to IR, with 46 rakes delivered between January-November 2016.

37. The second Component 1 activity, the acquisition of 108 bogie assemblies for EMU coaches, was transferred from MUTP-1 to MUTP-2A in the August 4, 2011 restructuring (Report No: 63374-IN). Siemens was the contractor for this activity. However, testing of initial bogie assemblies failed to achieve a required standard relating to oscillation. A Termination Notice was sent to Siemens on October 24, 2016, with MRVC initiation the process for “Termination for Default” under Clause 24 of General Conditions of Contract (GCC). In retrospect, the unintended outcome of this activity may be attributable to inappropriate contract specifications combined with an over commitment by the supplier to achieve the precise standards that were specified.

***Component 2 – Conversion of power supply from DC to AC (including improvements to signals and telecoms):***

38. The DC-AC conversion on CR was completed on April 10, 2016. While there were six cases of failures on 110 kV joints (out of a total of 130) due to workmanship quality these failures were addressed and there were no subsequent failures from June-December 2016. Regarding the digital axle counters, the performance of 1,199 track circuits at nineteen stations was generally satisfactory from commissioning until the final November/December 2016 Implementation Support Mission. Because of project-supported improvements to digital axle counters, there was a 61% reduction in track circuit failures. This was due to increased reliability of the signaling system, and improved functionality – particularly during seasonal monsoons which traditionally flood tracks and short out electrical components. This was critically important to improving operational efficiency and capacity, as envisaged by the PDO. Signal failures require reduced speeds and increased stoppages to mitigate safety risks and have historically constrained capacity and reliability of the suburban system.

***Component 3 – EMU maintenance and stabling lines:***

39. Substantial progress was made upgrading the capacity of EMU maintenance sheds and periodic overhaul workshops, but this work was not complete as of the November/December 2016 Implementation Support Mission since not all mechanical and plant (M&P) items had been delivered and commissioned. In addition, the planned establishment of 73 new stabling lines supported by the project were also not completed. On the CR, work was progressing on 29 stabling lines, with seventeen commissioned, and the remaining twelve lines scheduled for completion in January 2017. 26 of 42 lines were commissioned on the WR, with nine lines nearing completion and seven lines proposed to be carried forward in MUTP-3.

40. A new maintenance shed was built at the Virar facility which improved maintenance capacity and lessened the time required to inspect and maintain new rolling stock. The introduction of a bogey-drop table – the first of its kind in the IR system – along with the creation of a three-tiered inspection facility (with fully functioning platforms at each level)

are notable improvements to the maintenance regime. All Component 3 activities were fully financed by the Client.

***Component 4 – Capacity strengthening and technical assistance:***

41. Based on the results of the trespassing and safety action plan, prepared by the Sir J.J. College of Architecture in Mumbai and finalized in August 2012, the project financed works at twelve suburban rail stations. Interventions included the provision of: foot over-bridges (FOBs) along with extending, widening and improving interconnections between FOBs; additional platforms and widening and extending platforms; escalators and elevators; compound walls and fencing; track barricading; and green patches.

42. Along the CR, the following stations benefitted from trespass control measures: Dadar, Kurla, Kanjurmarg, Thane, Thakurli, and Kalyan. Along the WR, the Dadar, Kanivali, Borivali, Bhayander, Vasai and Nallasopara stations benefitted from project interventions. Contracts were awarded in March 2014 and the works were scheduled for completion by March 2017, with an impact assessment scheduled upon completion.

**2.3 Monitoring and Evaluation (M&E) Design, Implementation & Use**

43. The design of M&E indicators included several shortcomings. Indicators relating to capacity, headways, punctuality, journey times, and comfort suffered from their linkages to external factors that reduced measurement of and attribution to specific project interventions. Namely, an assumption that MUTP-2B works would allow for segregated operations of through trains and suburban trains as discussed in section 1.1. In addition, there was an assumption that the construction of Mumbai's metro rail network would complement project activities and assist in reducing levels of crowding. The design of the intermediate indicator relating to punctuality did not accurately consider the impacts that ongoing contemporaneous works under other initiatives would have. For example, punctuality on the Harbor Line did not consider how works to extend platforms for longer trains would affect delays. With perfect hindsight, it may have been more realistic to select a smaller set of more conservative indicators that were less subject to outside influence rather than including overall performance indicators relating to each line.

44. Indicators relating directly to rolling stock energy efficiency and institutional development in contrast were more realistically attributable to project interventions given the smaller number of exogenous factors that could impact outcomes. A more conservative approach to defining operational indicators could have identified similarly attributable indicators. For example, the number of track circuit failures or overall signal failures would have been suitable to capture benefits of the project's investments in digital axle counters. Similarly, average rake capacity for daily service could have provided a more attributable proxy for supplied capacity that could be specifically linked to EMU investments with less likelihood of exogenous impacts. In the case of both these examples, data was collected anyway by CR and WR as part of their standard business.

45. The methodologies followed for indicator data were broadly sound. Data was collected by the project's implementing agency, MRVC, along with CR and WR, which operate the suburban rail system. These represented the best sources for implementing data collection. The overall methodology for collection was reliable as it used established and

regularly updated systems that both CR and WR follow in their normal business. Two key issues however reduced the quality of M&E data as it was collected. Firstly, figures for passenger demand may not have ever been fully accurate as the suburban railway operates as an “open system” without gate controlled access that would allow for precise passenger counts. Instead, ticket sales offered a proxy which may expose demand figures to rates of fare evasion which is difficult to quantify. Secondly, the project and the Team observed two errors in how the PDO indicator relating to vehicle kilometers was defined in the PAD and subsequently collected, including: (i) an incorrect definition of “vehicle km per day during morning peak hours” when the baseline values corresponded to “vehicle km per day”; and (ii) the baseline value for CR Main Line (CR/ML) was incorrectly reflected in the PAD. Rather than 561,461 vehicle km per day, the correct baseline should have been 436,500 vehicle km per day. The Bank’s team and the project agreed to measuring the indicator as if it was defined as “vehicle km per day” (i.e. not just peak hours) and to consider 436,500 as the baseline indicator value for CR Main Line. This was an appropriate decision as it mirrored WR and CR’s normal methodologies for quantifying capacity. However, neither the formal indicator definition nor the baseline value for CR Main Line was officially revised in any of the project’s restructurings.

46. It is also clear that data from project indicators was used effectively in making decisions throughout MUTP 2A’s implementation. This was reflected in the studies conducted under the project’s TA component. Data used in these instances included both formal indicators as well as complementary subsidiary data. Analysis of services supplied and slab-wise analysis of ticket sales underpinned studies on revenue maximization and long term development planning for the suburban rail system. This data was linked to measures for vehicle kilometers per day and ridership per day as included in the M&E framework for MUTP 2A. Outputs from the studies supported by MUTP 2A data have also influenced the design of the forthcoming MUTP 3 project.

## **2.4 Safeguard and Fiduciary Compliance**

47. There were no major safeguard and fiduciary compliance issues encountered during implementation. MUTP-2A applied lessons learned from the previous MUTP-1 operation which involved a safeguards related Investigation Panel inquiry. The design of MUTP 2A had sought to minimize land acquisition or resettlement. The project also complied with EMP provisions, and effectively ensured for fiduciary and procurement compliance.

48. *Social Safeguards:* The project did not encounter notable adverse social impacts during implementation. The 2013 restructuring supported measures to reduce trespassing and enhance the safety of passengers, including the provision of lifts and elevators, foot over-bridges, track dividers, and the greening and reorganization of spaces to enhance hazard free and more efficient passenger movement in and around stations. All works were carried out within station premises did not require land acquisition or resettlement.

49. *Environmental Management:* There were no issues regarding environmental compliance during the project. At the time of MTR, there was broad compliance with the EMP provisions relating to work sites, especially in contracts being administered by MRVC. Sites were properly demarcated, dust control measures from site work and the transport of material were in place, and safety measures for workers were recorded on all sites. Tree planting and transplantation were undertaken for project Component 4 trespass control

activities where tree cutting was required to improve passenger movement in the station premises. Relevant government agencies were consulted, and permissions were granted for this work. There were no issues reported with respect to tree survival rates.

50. *Financial Management:* There were no major issues regarding compliance with financial management arrangements during the project, with claims regularly submitted to the Bank for processing, regular audits conducted, and counterpart funding from the GoM received, albeit after some initial delays.

51. *Procurement:* The November/December 2016 Implementation Support Mission reported that all major contracts were awarded, with most of them completed (except for the delivery of three twelve-car EMU rakes and ongoing trespassing control works). MRVC expected final delivery of remaining EMUs by the end of February 2017, and the remaining trespass control works was scheduled for completion by March 2017.

## 2.5 Post-completion Operation/Next Phase

### ***Transition Arrangement to Post Completion Operation and Maintenance***

52. IR and MRVC's development of the Virar maintenance facility is an important accomplishment relating to meeting the maintenance needs of increasingly complex rolling stock that was supported by the MUTP-2A project. The ICR Team visited the facility on January 30, 217 and observed enhanced maintenance capabilities, including a "three level" inspection and work structure that allows technicians to work under, within, and above trains more conveniently and more safely. MRVC and IR will need to ensure that the facility, along with others supported by MUTP-2A, are well maintained, fully stocked and staffed, and appropriately utilized based on a proactive maintenance practices. However, indications from the ICR team's visit suggest that these needs are being met at the time of project close.

53. Component 4 institutional development activities focused on providing sound, data-driven analytic work to inform the operation of the Mumbai regional rail network, and building the capacity of CR, WR and MRVC staff through targeted studies, trainings and study tours. The project successfully delivered these activities. However, with the notable exception of trespass control, there was limited progress on implementing reform initiatives in the broader environment at the national, state, and regional levels. This is understandable in the context of a sector with extremely challenging political economy considerations and institutional complexities. However, maximizing the value of investments in the suburban railway's infrastructure, operating assets, and institutions will ultimately require complementary enhancements in the enabling environment for service delivery. The institutional structure and operating focus of the suburban system will need to expand from a railways focused endeavor toward an agenda that focuses on transforming Mumbai's urban landscape, improving its international competitiveness, and enhancing the quality of life for residents. This will likely mean a closer integration between the suburban system and the municipal and state institutions that have jurisdiction over land use planning and complementary urban development initiatives.

54. A critical next step for the suburban rail system's evolution is improving services to meet increasing customer expectations. This implies significant investment to enhance (i.e. not just sustain) services. Specific examples include: (i) air conditioned rolling stock with

closing doors; (ii) station amenities such as shops, lighting, footpath connections, etc. (iii) increased frequency of service (upwards of 30 + trains per hour); (iv) integration with other modes of travel; (v) integrated ticketing and / or eventually integrated fares; (vi) transit oriented development to integrate the suburban rail system with land use planning. It is important to view investment needs in the context of a growing middle class that will increasingly have access to private modes of travel. In the past, ridership on the suburban system was largely captive (i.e. unable or unlikely to use other modes). However, this should no longer be taken for granted as incomes increase along with access to private modes. It is conceivable that the attractiveness of suburban rail services will need to improve over the medium and long term to sustain modal share.

55. International experience suggests that fares will need to be the primary source of revenues that fund investments to enhance services regardless of the financing approach adopted to structure payment over time. At present, Mumbai's suburban system operates at a marginal loss whereby operating expenses do not cover operating costs. In contrast, international experience suggests that fares should cover approximately 135% to 200% of the suburban rail system's operating costs to support the incremental investment likely to be required for renewals and enhancements. In achieving this, it will be important to adopt a fares adjustment approach that accounts for inflationary effects such that fares remain constant or increase consistently in real terms until sustainability could be achieved. A phased approach to subsidies could also complement this effort and prevent sudden fare increases. While fares are indeed a politically contentious issue, they can also be part of a virtuous circle whereby they support visible, customer-focused investments in service quality that maintain the relevance and attractiveness of services. Where subsidies are necessary to protect low income groups, targeting those subsidies to optimize their social value would likely be advisable.

56. GOI has requested a follow-up operation, which MRVC and the Bank are currently developing. This operation (MUTP-3), will build on MUTP-1, MUTP-2A, and counterpart initiatives that are under implementation. Government stakeholders and the Bank may wish to consider supporting the following key institutional reforms as part of this ongoing engagement: (i) a fares adjustment regime designed to support investments in service enhancement; (ii) multi-year investment program planning and governance systems; (iii) targeted subsidy schemes as required to guard affordability for low income groups; (iv) regular customer satisfaction surveys and indices; and (v) arrangements for multi-year funding settlement with GOM / GOI to support multi-year capital programs. Indicators that may be relevant to these initiatives include: (i) the "farebox recovery ratio" of suburban rail services which is the ratio of fares revenues relative to operating costs; (ii) the reinvestment rate which is the ratio of investment in renewals and enhancements to operating costs; and (iii) service quality indicators such as lost customer hours, mean distance between train failures, and peak hour reliability.

### **3. Assessment of Outcomes**

#### **3.1 Relevance of Objectives, Design and Implementation**

57. ***Objectives (rating – high):*** MUTP 2A's objectives aligned with the World Bank's Country Strategy for India (FY2009-12), which included three pillars: (i) rapid and inclusive growth; (ii) sustainable development; and (ii) service delivery. Specifically, the MUTP's

objectives contributed by helping to remove impediments to growth implied by the backlog of investment in Mumbai's suburban rail network despite increasing demand and population growth. In addition, MUTP's objectives contributed to sustainable development by enhancing the attractiveness of rail public transport as a low carbon mode while also improving the efficiency of that mode (esp. with respect to energy consumption). Lastly, MUTP's objectives to enhance the capacity of institutions involved in the suburban network were highly complementary to the aim of improved service delivery as were enhancements to infrastructure components that aimed at improved customer comfort. MUTP 2A's technical assistance component was also relevant to targeting future institutional enhancements at enhanced service delivery.

58. ***Design (rating – substantial):*** The design of MUTP 2A aimed at outcomes that were relevant to Mumbai's continued economic development. Specifically, the project's design focused on critical aspects of the suburban systems rehabilitation. Upgrades to signaling and rolling stock were logical design choices for improving services and achieving MUTP 2A's objectives. These investments offered cost effective solutions to affect changes that passengers perceive in their daily commutes in the form of reliability and comfort. Similarly, MUTP 2A's technical assistance activities were well designed for tackling highly relevant but institutionally complex issues such as fares, trespass control, and long term business planning. The objective analytics provided by MUTP 2A's studies helped to open new dialogues at senior levels of government. While these factors were strong, the weaknesses in the results framework limited the potential for measuring project impacts accurately.

59. MUTP 2A's relevance continued during implementation. The *India Country Partnership Strategy (FY2013-17)* recognized that while India's transport network is one of the most extensive in the world, accessibility and connectivity needed to be improved. Similarly, GoI's vision for development, outlined in the country's *12th Five-Year Plan (FY2013-17)*, recognized transportation challenges and called for accelerated development of India's transport infrastructure. MUTP-2A's PDO, and activities that comprised the project's four components, aligned closely with the broad transportation objectives in both of documents, along with previous Client and Bank strategic plans.

### **3.2 Achievement of Project Development Objectives**

#### ***Overall rating for efficacy: Substantial***

60. The PDO focused on four sub objectives including: (i) improving passenger carrying capacity; (ii) operational efficiency; (iii) passenger comfort; and (iv) institutional capacity. Achievement of these objectives were measured by six indicators that focused on: supplied railway capacity, peak hour overcrowding, journey times, energy efficiency, trespassing/safety and revenue improvement planning. The project fully achieved three indicators (energy reduction, and both action plan related indicators), partially achieved two indicators (capacity, over-crowding) and did not achieve targets relating to reduction in journey times.

61. ***Passenger carrying capacity sub-objective outcome is Substantial and passenger comfort sub-objective outcome is Moderate:*** Evaluating the PDO's achievement based on indicators that captured railway capacity and crowding is challenging as actual levels of

capacity (which affects crowding and comfort) depended significantly on factors that were outside the project's scope of influence. The indicators relating to vehicle kilometers also suffered from errors that were not formally corrected. Delays in MUTP 2B works, as discussed in section 1.1, invalidated many assumptions made during appraisal. Most notably, delayed MUTP 2B works had two effects on the achievement of target outcomes: (i) a reduction in vehicle kilometers where service extensions were not implemented as planned or expansion of services along existing routes was not possible due to conflicts with long distance trains; and (ii) ongoing works under MUTP 2B impacted railway services such that indicator values at MUTP 2A's closing represented a snapshot of services during a period of ongoing construction caused disruptions to services across the suburban network. It is worth noting that the target for vehicle kilometers on Harbor Line was exceeded by 66%. However, this can only partially be attributed to the project as a branch of Harbor Line services was extended to Thane during implementation along existing CR track which had the effect of increasing vehicle kilometers in a way not envisaged during appraisal.

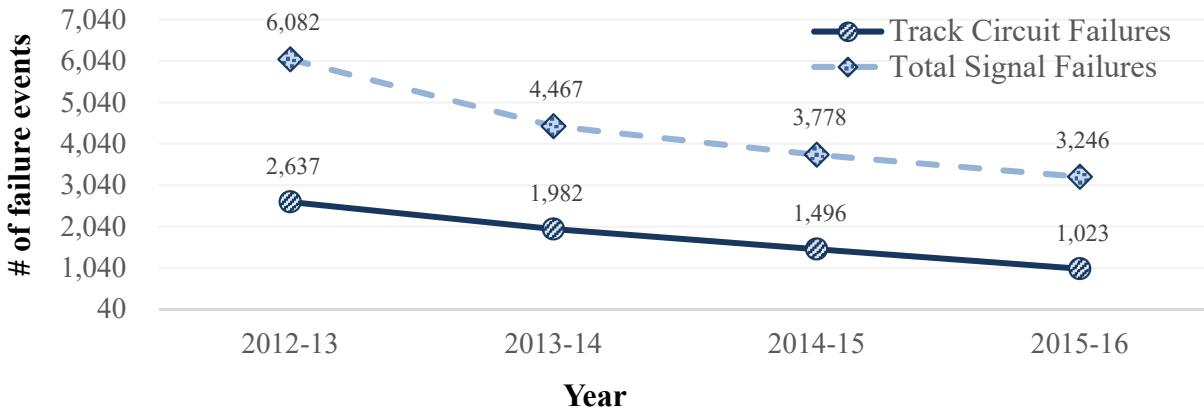
62. It is possible however to see attributable indications that the project made significant contributions to capacity and comfort when examining data that was not captured in formal M&E indicators. Annex 2 illustrates this in the form of overall service expansion on the suburban rail network using longer, larger capacity rakes across all lines. For example, MRVC has reported that Harbor Line was a primary recipient of new MUTP 2A rakes. Data on the number of Harbor Line services and the rake length of those services illustrates how this contributed to capacity increase. New EMU's enabled a wholesale shift from nine car rakes to twelve car rakes. Holding all else equal this shift expanded capacity by one third over the baseline value versus the original target that implied only a 21% increase in capacity.

63. Comfort is in part linked to capacity through crowding. In addition, comfort is also a function of onboard amenities such as airflow, seating, vibration, lateral acceleration, etc. These factors benefitted from new MUTP 2A rolling stock. The project did not achieve a reduction in crowding (except for Harbour Line) due to the factors discussed above which constrained capacity. However, the impact of project interventions on comfort were partially captured in the beneficiary survey described in Annex 5 which suggests high rates of passenger satisfaction with MUTP 2A rolling stock. This provides a qualitative but critical indication for perceived increases in onboard comfort by beneficiaries following the introduction of the project's new rolling stock. For example, 98% of survey respondents reported satisfaction with the seating configuration of MUTP 2A rolling stock. A further 93% reported satisfaction with the new forced air ventilation system.

64. ***Operational efficiency sub-objective outcome is Substantial:*** The project's achievements on operational efficiency are assessable, but only when combining both formal indicators and other sources of data as well as considering factors that were outside the project's control. Most notably, MUTP 2A's investments in digital axle counters directly reduced track circuit failures by 61% and signal failures by 47% by project close relative to 2012 levels (see Figure 1). Track circuits detect when a rake is occupying a specific length of track in order to prevent train collisions. This information feeds into the signaling system which controls the action of drivers. Historically, track circuits on Mumbai's suburban railway had experienced high rates of failure rate during monsoon rains. In contrast, digital axle counters do not malfunction when tracks flood and enable the

signaling system to function even when track infrastructure may be flooded. Signal failures had previously resulted in major inefficiency and service disruptions. The project's impact in this area is both attributable and highly relevant to enhanced operating efficiency. Signaling is amongst the suburban railways most important systems for efficient operations and the project's achievements in this regard are extremely positive. Anecdotally, there were reported instances of drivers calling ahead to stations with concern when they saw signals actually working during heavy rains following project works.

**Figure 1 Reductions in track circuit failures and other signal failures**



65. The PDO indicator for energy consumption, which was attributable to project works also showed that results from MUTP 2A's DC to AC conversion had exceeded expectations with 106% of envisaged energy savings achieved. In contrast, the intermediate indicator relating to journey times, which is an important measure of operational efficiency, showed no improvement over the course of project implementation. This was reportedly due to the presence of older rolling stock that is still operating on the suburban network at reduced levels of performance with respect to acceleration, braking, and speed. Older rolling stock has limited faster journey times for all rolling stock and prevented revision of service schedules. MRVC reports that there were approximately 51 rakes still running with older, antiquated technology of which 10 operate on the Western Railway and 41 operating on the Central Railway (including Harbour Line) such that the three delayed MUTP 2A rakes yet to be delivered at the time of project close are not responsible for the presence of older rolling stock on the network.

66. Operating efficiency considerations related to punctuality of service were captured by an intermediate indicator. However, this showed a decrease in achievement as the number of delays increased by project close. The contrary result in this instance was reportedly due to service disruptions resulting from MUTP 2B works that remain ongoing, including the addition of the 5th and 6th line from CST to Kurla which is causing delays on WR along with trespass control works and Andheri–Goregaon works. On the Harbor Line, ongoing works to extend station platforms have had a similar effect on punctuality as well as the number of services that could be offered in the peak hour. Importantly, delays in MUTP 2B works have also forced the suburban system to continue sharing track with long distance trains which also affects reliability, speed, and overall efficiency of services. Again, the issue of attribution between indicators and project interventions complicates an assessment

of MUTP 2A's achievements when judged solely by M&E indicators which were significantly affected by external circumstances.

67. ***Institutional development sub-objective outcome is Substantial:*** The project's contribution to institutional capacity is clear. Studies that formed the backbone of MUTP 2A's technical assistance program have opened new dialogues between institutions and provided support in the form of analytical inputs to those discussions. In Mumbai's context, this represents an important starting point for more ambitious institutional development initiatives. Perhaps most notably, the study relating to a Trespass Control Action Plan (i.e. one element of institutional capacity) resulted in positive actions being taken via the project in the form of works following the 2013 restructuring. In the context of institutional difficulties that previously inhibited progress on this key agenda, the project's accomplishments are particularly formidable. In addition, the analytical work on non farebox revenues and long term strategic planning have supported new policy dialogues about the future of Mumbai's suburban system and how to ensure its sustainability. Lastly, studies relating to passenger information, and ticketing have helped MRVC advance further towards customer centric thinking which will become increasingly important as customer expectations will likely rise as incomes increase.

### **3.3 Efficiency**

#### ***Rating: Substantial***

68. Economic analysis of the project considered the following: (i) incremental operating costs; (ii) incremental capital costs; (iii) time savings due to reduced journey times; (iv) benefits of reduced crowding and discomfort for passengers on both bus and rail services; (v) reduced bus operating costs; and (vi) reduced bus emissions. Project benefits were calculated for the 25-year period following project completion, from 2017 to 2042. The project's estimated Net Present Value (NPV) is US\$ 515 million in 2017 prices with an EIRR of 20 percent. The summary of estimated benefits relative to appraisal forecasts is shown in Annex 3.

### **3.4 Justification of Overall Outcome Rating**

#### ***Rating: Moderately Satisfactory***

69. Overall, the project achieved a Moderately Satisfactory rating in terms of the overall outcomes achieved, based on the combined ratings for Relevance, Achievement of the PDO, and Efficiency. The overall objectives of improved passenger carrying capacity, operational efficiency, passenger comfort, and institutional capacity were relevant at the time of appraisal, and this remained throughout implementation. However, the project's M&E framework was not properly designed to capture the attributable factors that related to the PDO's achievement which complicates an assessment of overall outcomes based on indicators alone. Nevertheless, the project's interventions achieved the PDO when measured by alternative attributable criteria. Moreover, the project's efficiency was greater than envisaged. Taken in totality, these outcomes support a Moderately Satisfactory rating.

### **3.5 Overarching Themes, Other Outcomes and Impacts**

#### ***(a) Poverty Impacts, Gender Aspects, and Social Development***

70. Recognizing the challenges associated with mobility and accessibility issues for women commuters, a gender study of the Mumbai suburban rail system was conducted. A series of recommendations were included in this study to address these issues. MRVC has begun implementing some of these recommendations and is in discussions with the Bank on how to continue this work under MUTP-3.

#### ***(b) Institutional Change/Strengthening***

71. MUTP-2A supported a data-driven, analytic process to broadly address safety issues for suburban rail passengers and communities living along CR and WR corridors in the MMR. This was a particularly important contribution to institutional capacity. The operation specifically focused on using data to identify and supporting pilot works projects to prevent trespassing and decrease trespassing-related injuries and fatalities at twelve stations (six along the CR, six along the WR).

72. Interventions to improve passenger safety on trains, related specifically to overcrowding and operating with open doors, are also being seriously considered because of MUTP-2A's accomplishments, and will likely be progressed under the forthcoming MUTP-3 project. This represents an important and noteworthy paradigm shift in suburban rail operations for the MMR, and can contribute to improvements to these operations commensurate with aspirations to establish MMR as a world-class, international urban center and gateway to trade and investment in India more generally.

73. The project also strengthened MRVC capacity to coordinate the further development of suburban rail services in the MMR in a strategic sense (i.e. beyond just implementing capital investment). Specifically, the studies supported under MUTP-2A "broke the ice" in considering critical issues such as financial planning and fares policy, ticketing systems, long term capital planning, and broader customer amenity issues. Within the complex institutional environment that exists, the dialogue created by MUTP-2A opened opportunities for engagement around significant institutional reforms in the future.

### **3.6 Summary of Findings of Beneficiary Survey**

74. MRVC commissioned a third party to survey commuter passengers on the amenities provided in the twelve-car rakes developed and commissioned into service with MUTP-2A financing. 1,500 first and second class passengers were surveyed an independent private firm from March 16-20, 2016. Passengers were asked about the following characteristics of the newly designed train compartments: seating pattern, leg space, visibility of passenger information system, ventilation system, electrical fittings, handles for standing passengers, height and width of luggage rack, window size, center pole for boarding and alighting, and the width of first and second class seating. The overall satisfaction with these amenities 87.08%, with the lowest favorable rating 82% and the highest rating 92%. The results suggest a high degree of satisfaction with MUTP 2A rolling stock.

## **4. Assessment of Risk to Development Outcome**

### ***Rating: Moderate***

75. The ICR team rates the risk to development outcome as Moderate. Achievements with respect to carrying capacity and operational efficiency, as envisaged by the PDO are likely to be sustainable in the context of DC to AC conversion, signaling upgrades, enhanced rolling stock capacity, improved maintenance facilities, and stronger maintenance practices that have resulted from the MUTP-1 and MUTP-2A projects. These enhancements have created constructive obligations to sustain if not improve services further – particularly in the context of rising customer expectations.

76. However, risks remain to the sustainability of passenger comfort and institutional capacity. International experience has shown that urban rail systems require continuous programs of service enhancement to keep up with evolving customer expectations. A key factor in the execution of these programs is the stability and reliability of funding which is linked to a sustainable fares policy. Mumbai's suburban system currently does not have an agreed way forward on fares and government subsidies are required for both operations and new capital investment. Fares are an issue with complex political economy considerations that will eventually need to be addressed. Similarly, the institutional capacity that MUTP-1 and MUTP-2A has developed is linked to the role that MRVC will play going forward. It is unlikely that MRVC would discontinue its current functions, yet there is an unaddressed need to consider what MRVC's full future role may resemble. In totality, these factors justify a Moderate risk rating to development objectives which future Bank engagements could seek to address.

## **5. Assessment of Bank and Borrower Performance**

### **5.1 Bank Performance**

#### ***(a) Bank Performance in Ensuring Quality at Entry***

##### ***Rating: Moderately Satisfactory***

77. The Project's four components were technically sound and reflected the intended development objectives. Financial assumptions were based on thoughtful economic analyses, and the devaluation of the INR based on the GoI's monetary policy was initiated after appraisal and could not reasonably have been predicted at preparation. This was a key reason for the partial cancellation of loan funds. Safeguard standards were appropriate, and based on lessons learned from MUTP-1. The Bank's decision to engage with MRVC on enhancing Mumbai's suburban rail system was strategically sound, relevant, and in line with both Client and Bank strategic objectives.

78. While the project's activities aimed at strategically relevant topics, overall quality at entry was moderately satisfactory primarily because of deficiencies in the Monitoring and Evaluation framework provided at entry. This was heavily dependent on factors that were outside the scope of the project or even the Implementing Agency's general scope of authority and the projects scope of potential impact. MRVC exercises neither operating authority over the suburban system nor absolute control over parallel projects. The complexity of railway operations and the myriad of factors that affect operating indicators were not well considered in the design of indicators.

*(b) Quality of Supervision*

**Rating: Moderately Satisfactory**

79. The Bank adequately considered fiduciary and safeguard policies at entry, and provided proactive supervision throughout implementation. There was strong coordination and cooperation between the Bank and MRVC during Implementation Support Missions, and the Aide Memoires documented progress, clearly highlighted implementation challenges, and provided realistic, time-bound mitigation strategies. When there were delays in Component 1 activities related to the testing and approval of prototype train sets by RDSO, and the subsequent production of approved train sets by ICF, the Bank partnered with MRVC to engage RDSO and ICF to resolve these challenges as quickly as possible. This was well captured in project documents, including Aide Memoires, ISRs, the MTR, and email communications. While the delivery and commissioning of all 72 rakes was not complete by the end of the project, the Bank and Client's productive approach to early delays resulted in a compressed production and delivery schedule that substantially reduced the backlog by the end of the project such that all but five out of 258 new EMUs had been delivered by the closing date with the balance expected for delivery in late spring 2017.

80. The supervision team's work with MRVC and other stakeholders to restructure the project in 2013 and advance the railway safety agenda was a very positive accomplishment. The introduction of trespass control works demonstrated an effective use of the Bank's convening potential in the context of an institutionally challenging environment. Despite these accomplishments, a key shortcoming in supervision was the missed opportunity to restructure the project's results framework.

*(c) Justification of Rating for Overall Bank Performance*

**Rating: Moderately Satisfactory**

81. The rating for overall Bank performance is Moderately Satisfactory. Supervision was satisfactory overall and may have warranted a higher rating but for the fact that deficiencies relating to a moderately satisfactory quality at entry were not adequately addressed. Specifically flaws in MUTP-2A's results framework were apparent from early stages of the operation yet none of the project's four restructurings took the opportunity to address these shortcomings. A Moderately Satisfactory overall rating for Bank performance is therefore justified.

## **5.2 Borrower Performance**

*(a) Government Performance*

**Rating: Satisfactory**

82. The rating for Government Performance is Satisfactory. There were three main Government entities, with different mandates, that were required for the successful implementation of this project: MRVC (as the implementing agency with capital expenditure authority), IR (as the operator of the suburban rail system) and the GoM (as the state government with public land use and urban planning authority). All three effectively worked together during implementation. The complex arrangement of divided authority between these three stakeholders is described below.

83. The MRVC was incorporated under the Companies Act, 1956 as a “Public Sector Undertaking”, limited by shares, of the GoI under IR. Because MRVC is owned almost equally by the GoM and IR, the performance of both public entities, along with the MRVC, was essential for project success. In addition, both GoM and IR shared the investment costs of the project on a 50:50 basis - making both beneficiaries and stakeholders of the project. Overall, IR and the GoM recognized the importance of this project to the MMR, and were supportive of all phases of the project life cycle. While there were initial delays relating to MRVC receipt of GoM counterpart funding, this was resolved with minimum impact on the project. GoM, WR, CR and IR Railway Board officials met regularly and productively with Implementation Support Missions, and supported MRVC’s efforts to efficiently and effectively implement the Project on a timely basis. Government counterparts showed responsiveness to addressing issues raised by the bank during implementation.

**(b) Implementing Agency or Agencies Performance**

**Rating: Satisfactory**

84. The rating for implementing agency performance is Satisfactory. Throughout project preparation and implementation, MRVC was a strong and effective partner, despite its complicated relationship with IR and GoM described above. MRVC worked collaboratively with the Bank to address challenges such as delays in the first component, specifically related to design approvals of the electrical equipment for the 72 twelve-car rakes financed by the project. Once the designs were approved and ICF could begin production, MRVC also worked with the Bank and ICF to develop an expedited production timeline so that production would be complete by the end of the project. The extension of the closing date from June 15, 2015 to December 31, 2016 provided the time needed for ICF to deliver and for MRVC to commission 95.8% of the 72 rakes by project end (the remaining rakes were delivered in the spring of 2017). MRVC effectively completed the DC-AC currency conversion and signal work before the project ended, and completed all but one of the capacity building studies in time (with the final outstanding study reaching completion in spring 2017). Some trespassing prevention works were still being built after the project ended but were envisaged to complete within 2017.

**(c) Justification of Rating for Overall Borrower Performance**

**Rating: Satisfactory**

85. Based on the performance of the Government and Implementing Agency described above, the overall Borrower performance is rated as Satisfactory. It is particularly important to note MRVC’s context in parallel with project achievements. While neither controlling operations on the railway nor the approvals for rolling stock development MRVC managed to effectively implement a significantly complex capital program effectively. This was achieved in the context of a railway where the intensity of operations complicated implementation of physical works on operating lines.

## **6. Lessons Learned**

86. *Take advantage of the Bank’s convening ability and flexibility offered by restructurings during implementation to tackle incremental challenges:* Throughout project implementation, the Bank proactively and effectively convened the implementing agency, MRVC, along with other stakeholders required for decision-making or decisive action. This

was particularly effective in developing an approach to reduce accidents and fatalities through improved trespass control. The team successfully deployed the Bank's convening power to address institutional coordination issues that had previous hindered progress on this key agenda. The Bank should enable and encourage teams to use convening power and the flexibility offered by project restructurings to tackle incremental issues during implementation.

87. *Select attributable indicators and take action when indicators and targets are observed to be outside the project's manageable scope:* The indicators and targets developed for MUTP-2A reflected an assumption that MUTP-2B activities would be implemented in a phased manner that complemented MUTP-2A activities. It is not uncommon to observe similar situations when dealing with an extensive transport system in a rapidly developing city. However, the experience of MUTP-2A raises a question of whether the indicators selected were ever appropriate in terms of attribution and may have been overly ambitious from the outset. A key lesson is that given the complexities of large urban transport systems and the inevitable presence of exogenous factors, teams should be conservative in selecting indicators that are strongly attributable to a project intervention. If the realities of implementation prove otherwise, teams should also act to restructure indicators towards measures that provide credible attribution.

88. *Plan for the development of new rolling stock configurations differently than rolling stock procurement:* The interface risk that MUTP 2A encountered in the development of a new rolling stock platform is not unprecedented and is in fact common in situations where existing systems endeavor to integrate new rolling stock designs with legacy station platforms. Had MUTP-2A's preparation better reflected this risk it may have been possible to reduce delays through additional engineering due diligence, formal coordination mechanisms, and / or more proactive engagement around the design and approvals processes. A key lesson for future urban rail projects is to treat the risk of developing a new rolling stock configuration very differently than the risks associated with procuring rolling stock that follows a design that is already in operation on an urban rail system.

89. *Shape institutional capabilities and mandates toward opportunities for long-term sustainability and enhanced effectiveness.* Under MUTP-1 and MUTP-2A MRVC's nominal role is an implementing agency for capital investment. There are inherent limitations to this approach as illustrated by MUTP-2A's challenges of executing works along an operating railway that is managed by other stakeholders. However, the experience of MUTP-1 and MUTP-2A has developed MRVC's capacity to both manage the tangible aspects of a complex capital program and to also support the achievement of policy objectives that go beyond its current mandate. Specifically, the studies performed under MUTP-2A's technical assistance component that have increased MRVC's understanding for long term planning, customer service enhancements, non-farebox value capture, and safety. MUTP-2A demonstrated that shaping an implementing agency's capabilities with a view to tackling longer term sustainability challenges can offer an effective first step in an environment that otherwise enables no immediate practical solutions for a major restructuring of institutions.

**7. Comments on Issues Raised by Borrower/Impl. Agencies/Partners**

**(a) Borrower/implementing agencies**

90. No written comments were received.

**(b) Cofinanciers**

n/a

**(c) Other partners and stakeholders**

n/a

## Annex 1. Project Costs and Financing

**Table 1 Project Cost by Component (in USD Million equivalent)**

Components	Appraisal Estimate (USD millions)			Actual/Latest Estimate (USD millions)			Percentage of Appraisal
	WB	Counterpart	Total	WB	Counterpart	Total	
<b>Component 1</b>							
Rolling stock fleet increase	355,700,000	303,900,000	659,600,000	197,629,429	312,463,332	510,092,761	77%
<b>Component 2</b>							
DC to AC conversion	55,200,000	118,600,000	173,800,000	52,145,447	78,920,018	131,065,465	75%
<b>Component 3</b>							
EMU Maintenance Facilities and Stabling Lines	-	117,700,000	117,700,000		85,682,549	85,682,549	73%
<b>Component 4</b>							
Technical assistance	14,400,000	200,000	14,600,000	29,254,939	8,367,005	37,621,945	258%
<b>Unallocated</b>							
<b>Total Baseline Cost</b>	425,300,000	540,400,000	965,700,000	279,029,815	485,432,904	764,462,719	79%
Unallocated	3,700,000	-	3,700,000	-	-	-	0%
Front-end fee PPF	-	-	-	-	-	-	-
Front-end fee IBRD	1,075,000	-	1,075,000	1,075,000	-	1,075,000	100%
<b>Total Financing Required / Expended</b>	430,075,000	540,400,000	970,475,000	280,104,815	485,432,904	765,537,719	79%

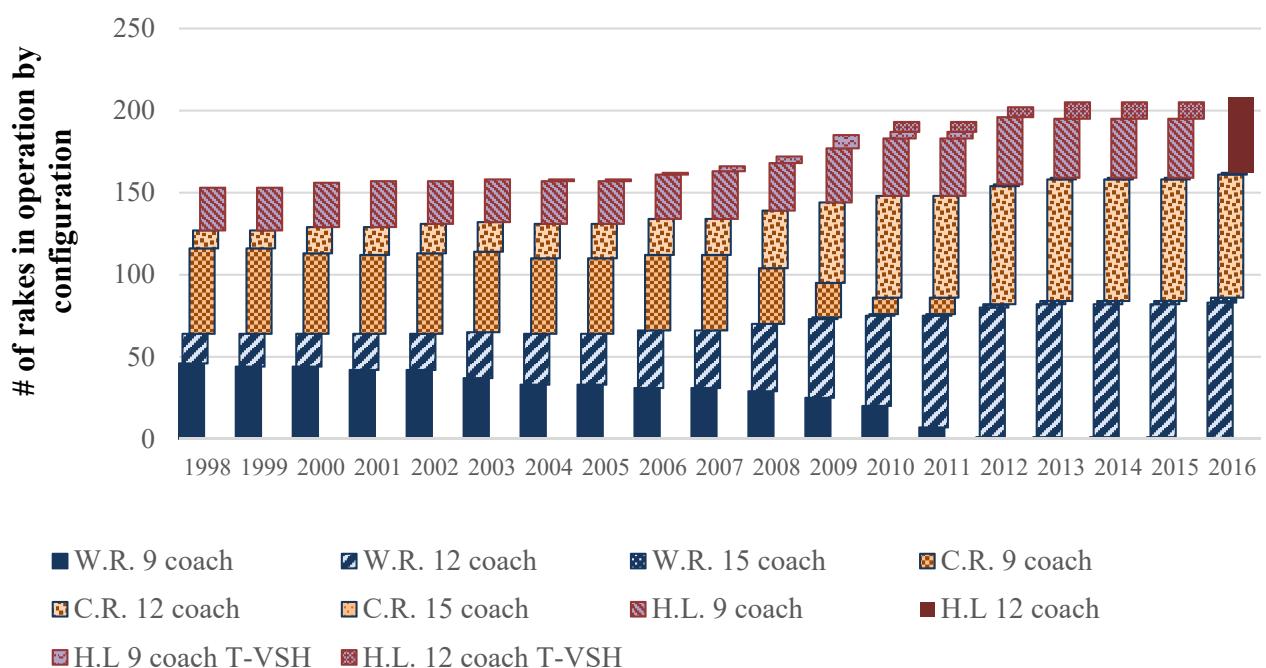
**Table 2 Financing**

Source of Funds	Type of Cofinancing	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
Borrower	Joint	540.4	485.4	89.8
International Bank for Reconstruction and Development	Joint	430.0	280.1	65.1

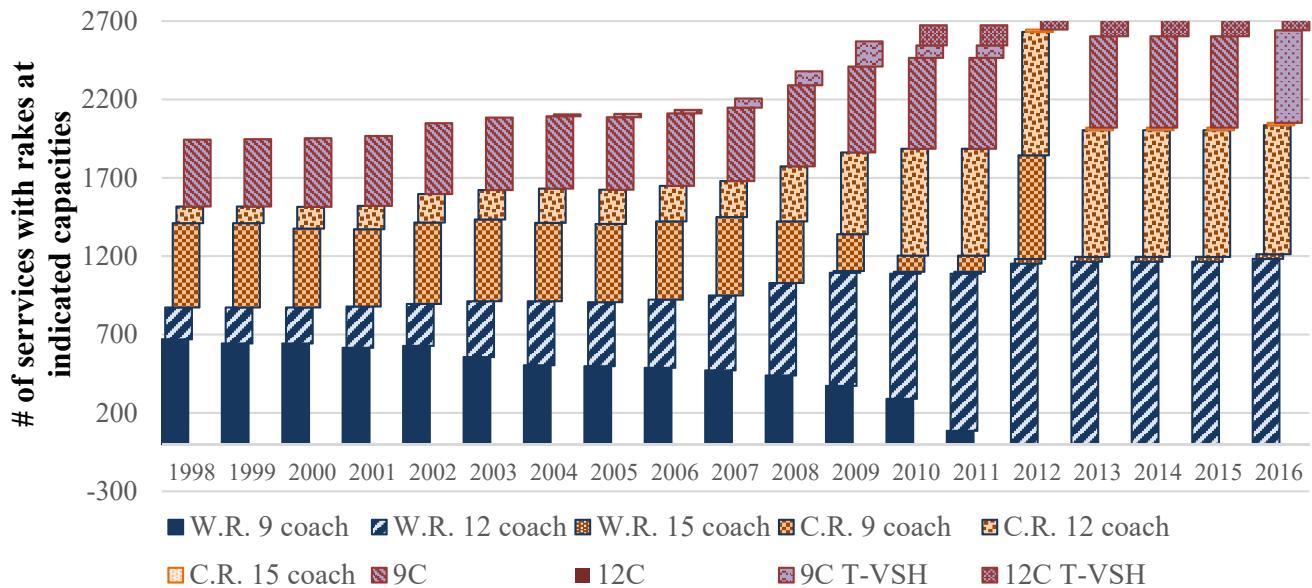
## Annex 2. Outputs by Component

91. *Component 1 – Electric Multiple Unit (EMU) rolling stock increase:* The project supported the procurement of 864 additional EMU cars (72 twelve-car rakes), with the Bank loan financing the electrical equipment for the new cars manufactured at the Chennai ICF, and the client financing the remaining costs of production. As of December 31, 2016, a total of 69 rakes were delivered, fully commissioned, and in use, with the remaining three expected to be delivered. The regenerative brakes feature of the new rolling stock reduced energy consumption by 35 percent, saving operating costs and reducing carbon emissions. The impact of new rolling stock from both the project and other sources on the suburban fleet is shown below and illustrates increasing rake size which is an important determinant of supplied capacity as well as an overall service expansion across the network.

**Figure 2 Evolution of the suburban railway rolling stock fleet**



**Figure 3 Expansion of services using higher capacity, more frequent trains**



World Bank Analysis of MRVC data. Note: T-VSH = Thane to Vashi

92. The second Component 1 activity was the acquisition of 108 Bogie assemblies for EMU coaches, including support for the design, manufacturing, testing and commissioning of the assemblies. This activity was transferred from MUTP-1 to MUTP-2A in the August 4, 2011 restructuring (Report No: 63374-IN). Siemens was the contractor for this activity. MRVC proactively followed up on the fulfillment of this contract but was not successful in moving this forward. A Termination Notice was sent to Siemens on October 24, 2016, with MRVC initiation the process for “Termination for Default” under Clause 24 of GCC.

93. *Component 2 – Conversion of power supply from DC to AC (including improvements to signals and telecoms):* The project supported the conversion from 1,500V DC traction to 25kV AC in three sections of the MMR’s CR along with the supply and installation of digital axle counters. Signaling conversion had a particularly significant impact on the suburban railway’s operations. Over the life of MUTP 2B, track circuit failures (i.e. failures in the devices used to detect the absence of a train, fell by 61% and overall signal failures fell by 47%. This was critically important to improving operational efficiency and capacity as signal failures require reduced speeds and increased stoppages to mitigate safety risks – especially during seasonal monsoons when annual flooding regularly triggered mass signal failure events.

94. The DC-AC conversion on CR was successfully completed on April 10, 2016. Regarding the digital axle counters, 1,199 track circuits (originally 1,095) consisting of 1,584 points (originally 1,503) at all nineteen stations were successfully installed and commissioned by February 2016. In addition to creating the capacity to run more trains, this component facilitated energy savings by cutting transmission losses, reducing the need for maintenance power supply installations, and regenerating electricity during braking.

95. *Component 3 – EMU maintenance and stabling lines:* Substantial progress was made upgrading the capacity of EMU maintenance sheds and periodic overhaul workshops, but

this work was not complete as of the November/December 2016 Implementation Support Mission since not all M&P items had been delivered and commissioned. In addition, the planned establishment of 73 new stabiling lines supported by the project were also not completed. On the CR, work was progressing on 29stabiling lines, with seventeen commissioned, and the remaining twelve lines scheduled for completion in January 2017. 26 of 42 lines were commissioned on the WR, with nine lines nearing completion and seven lines proposed to be carried forward in MUTP-3. All Component 3 activities were fully financed by the Client, with no Bank funds used.

96. *Component 4 – Capacity strengthening and technical assistance:* A total of seven strategic and tactical studies were conduct and two simulation software packages were procured with project support. Two planned studies were dropped since similar studies were conducted by other agencies (MMRDA and IR, respectively). A total of 81 professional staff received training in a range of topics that focused on further developing planning and operational capacities of Mumbai suburban rail stakeholders. This includes seven workshops, four seminars, and four study tours.

***Strategic studies:***

- (i) Preparation of a priority development program for the Mumbai suburban rail services consistent with the *TranSforMStudy* and including feasibility studies (completed);
- (ii) Development of IR's long-term strategy to implement Vision 2020, with a focus on suburban rail services (completed);
- (iii) Improvement of the financial situation of the Mumbai suburban rail operation by maximizing non-farebox revenues (completed); and
- (iv) Gender issues in Mumbai suburban rail system (added during implementation).

***Tactical studies:***

- (i) Establishment of an improved ticketing system for the Mumbai suburban rail service (dropped since similar activity carried out by MMRDA);
- (ii) Design of an improved passenger information system (dropped since similar activity carried out by IR);
- (iii) Plan for reducing accidents due to trespassing (two parts: stations and mid-sections - completed);
- (iv) Identification of specific improvements to environmental practices in CR and WR operations (completed); and
- (v) Controlled trespassing works over railway track of suburban railways at station areas in Mumbai (added during implementation)

***Capacity building focused on the supply and installation of software for***

- (i) The procurement and installation of software for improved power supply and rail operations simulations (completed), and

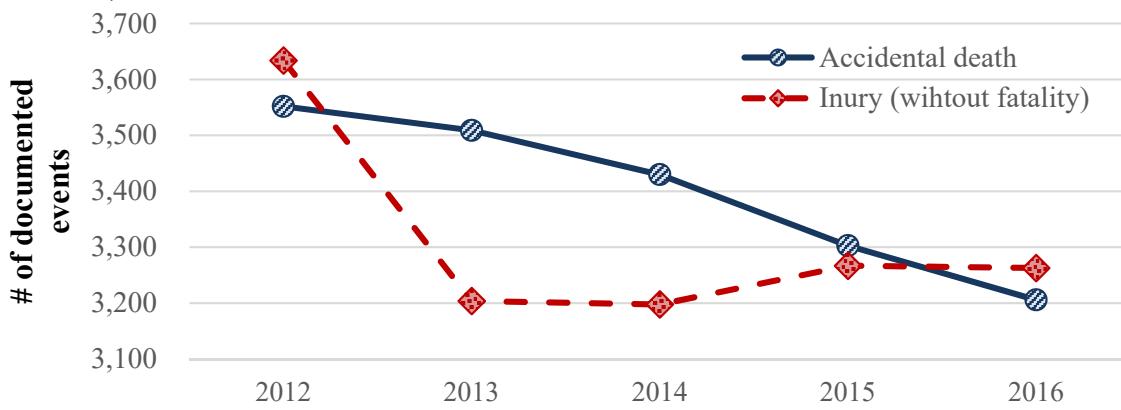
- (ii) Training and study tours to reinforce professional efficiency of MRVC officers based on approved training plan (completed).

97. Based on the results of the trespassing and safety action plan conducted by the Sir J.J. College of Architecture in Mumbai and finalized in August 2012, the project financed works at twelve suburban rail stations. Interventions include the provision of:

- (i) Foot over-bridges (FOBs) along with extending, widening and improving interconnections between FOBs;
- (ii) Additional platforms and widening and extending platforms;
- (iii) Escalators and elevators;
- (iv) Compound walls and fencing;
- (v) Track barricading; and
- (vi) Green patches.

98. Along the CR, the following stations benefitted from trespass control measures: Dadar, Kurla, Kanjurmarg, Thane, Thakurli, and Kalyan. Along the WR, the Dadar, Kanivali, Borivali, Bhayander, Vasai and Nallasopara stations benefitted from project interventions. Fifty undergraduate students, 24 graduate students, and around thirteen faculty members at the Sir J.J. College of Architecture conducted field research and analyzed the data used for the trespassing and safety action plan that informed the Component 4 works funded by the project. Contracts were awarded in March 2014 and the works are scheduled for completion in early summer 2017. An impact evaluation is scheduled to take place once sufficient time has elapsed to perceive cause and effect of specific interventions. While the overall rate of accidents on the suburban network remains high, there does appear to be a declining trend in fatalities albeit in the presence of a gradually increasing trend in injuries.

**Figure 4 Trends in accidental deaths & injuries without fatalities (Mumbai Suburban)**



Source: World Bank Analysis of WR and CR data

### Annex 3. Economic and Financial Analysis

#### *Introduction*

99. This annex documents the economic re-evaluation of the MUTP2 project undertaken on the Mumbai suburban system between 2010 and 2017. It is based on data collected during a mission in January 2017. The estimated economic return is about 20%, compared to 17 % in the original evaluation, due to the reduced level of operations (and hence additional cost), partially balanced by a lower growth in demand compared to that assumed at appraisal. These factors reduced the increase in operating cost in the ‘with-project’ case but also reduced the user benefits (especially relief from crowding), leading to a slight increase in net benefits overall.

#### *Project summary*

100. At appraisal, the project had four components, with the first three designed to provide additional train services on the Mumbai suburban rail network. The fourth component, technical assistance, was intended to strengthen the institutional and managerial capacity of MRVC and IR (Table 3). Its total cost was estimated at US\$970.5 million, of which the IBRD loan was US\$430 million.

**Table 3 Project Components and Costs (US\$ million, including contingencies)**

	<i>Project Component</i>	<i>IBRD Loan</i>	<i>Counterpart Funding</i>	<i>Total Cost</i>
1	Rolling Stock Fleet Increase	355.7	303.9	659.6
2	DC to AC Conversion	55.2	118.6	173.8
3	EMU Maintenance Facilities and Stabling Lines	0	117.7	117.7
4	Technical Assistance	14.4	0.2	14.6
	Front-end Fee	1.075	-	1.075
	Unallocated	3.7	-	3.7
	<b><i>Total Financing</i></b>	<b><i>430.0</i></b>	<b><i>540.5</i></b>	<b><i>970.5</i></b>

Note: Physical and price contingencies are all included

101. Under *Component 1*, 864 additional EMU cars were to be procured, increasing the total fleet to around 3,124 cars. As the power supply was to be converted from DC to AC before these cars entered service, they were designed for use on 25KV AC system only. This activity was expected to be completed by 2014-15 but has taken until 2017-18.

102. *Component 2* involved converting three sections of the Central Railway network from 1,500V DC traction to 25KV AC, including modification of the signal and telecom systems. The conversion was planned to be completed by 2012-13. In practice it was completed in 2015-16. AC power supply systems have reduced transmission losses, require fewer substations and support regenerative braking with a significant saving of traction energy.

103. *Component 3* comprised new stabling lines at Kurla (CR) and Virar (WR) to accommodate the increased fleet additional trains supplied under the project.

104. *Component 4* consisted of strategic and tactical studies together with capacity building and training.

105. Two changes were subsequently made to the scope of work involving the IBRD funds:

- (i) In 2011 component 1 was extended to cover the supply of 108 bogie assemblies originally included in MUTP1. No additional cost was involved as significant savings were expected on the appraisal cost estimate; and
- (ii) In 2013, savings of US\$75 million for component 1 had been identified; \$30 million of this was allocated to component 4 for ‘associated measures related to passenger safety and to prevent trespassing’. In practice, this has meant strengthening fencing and implementing related works at selected stations’. The remaining US\$45 million was surrendered. A further saving of US\$35 million was surrendered by the Railway Board in 2015, despite a proposal by MRVC to use it to procure an additional 153 carriages

106. The safety measures are currently in progress and it is thus difficult to assess their impact. There was also no economic evaluation undertaken before this change was made. However, there are over 2000 fatalities annually on the Mumbai suburban system, two-thirds of which are due to ‘trespassing’, much of which is passengers crossing running lines to get from one platform to another. As this expenditure will only need to save [x] lives annually to pay for itself economically it is almost certain to be justified.

107. The MUTP2 project also included parallel government efforts on four subprojects to increase network capacity:

- (i) 5th & 6th Lines CSTM-Kurla;
- (ii) 5th & 6th Lines Thane-Diva;
- (iii) 6th Line Mumbai Central-Borivali; and the
- (iv) Extension of Harbor Line from Andheri to Goregaon.

108. One of these (Thane – Diva) had been completed by early 2017 and the Andheri – Goregaon project is close to completion. The other two are now planned for completion in 2021. As these projects are not fundamental to the components included in Table 1 they have been excluded from the evaluation.

109. During the project timeframe, the conversion of several sections of the CR from DC to AC, funded outside MUPT2) was completed:

- (i) Kasara – Kalyan (2013-14);
- (ii) Kurla – Thane (5<sup>th</sup> and 6<sup>th</sup> lines) (2013-14);
- (iii) Kalyan – Thane (2013-14);
- (iv) Thane – CSTM (2014-15);
- (v) Panvel – CSTM (2016-17);
- (vi) Thane – Turhe – Vashi (2016-17); and
- (vii) Wadala – Mahim (2016-17).

110. All the suburban network had now converted to AC and the dual-voltage sets can begin to be phased out. During the project period, improvements were also made to station

facilities and by November 2011, CR was entirely operated with 12 car trains and in 2012-13 some 15-car trains also began operating.

#### ***Passenger demand and train operations***

111. Table 4 summarizes the key demand and operating parameters of the Mumbai system for 2015-16 and compares them with those projected at appraisal.

**Table 4 Demand and operations – appraisal and actual**

	2006/7		2014/15		2014:2015
	Appraisal	Actual	Appraisal	Actual	Appr:modl
Passengers (million)	2648	2515	3282	2710	83%
Passenger-km (million)	82007	82846	105354	90436	86%
Lead (km)	31	33	32	33	118%
Train-km (000)	36688	33960	54819	44447	81%
Vehicle-km (million)	385	330	635	513	81%
Vehicles per train	10.5	9.7	11.6	11.5	99%
Passenger-km:vehicle-km	213	250	166	176	106%
Route-km	319	319	383	383	100%
Average speed (km/hr)	39	39	42	39	93%
Real fare incl surcharge (Rs/pkm)	0.29	0.31	0.17	0.19	110%
Earnings (Rs current)	11479	12829	14869	20496	138%

112. Actual demand has turned out to be rather less for passengers than forecast, by over 20%. Given that the key factors of crowding (passenger-km:vehicle-km) and real fares for 2014/15 are very similar between the appraisal forecasts and the outturn, this indicates that rate of growth in demand is slowing after growing rapidly through the 1980s, 1990s and early 2000s. However, it may be that crowding is still suppressing growth in certain parts of the system, especially in the central sections of WR, where it is almost physically impossible to board trains at many stations during the rush hours (and not so easy during the rest of the day). The reduction in crowding has been concentrated in CR, thanks to the introduction of 12 and (more recently) 15-car rakes during the period.

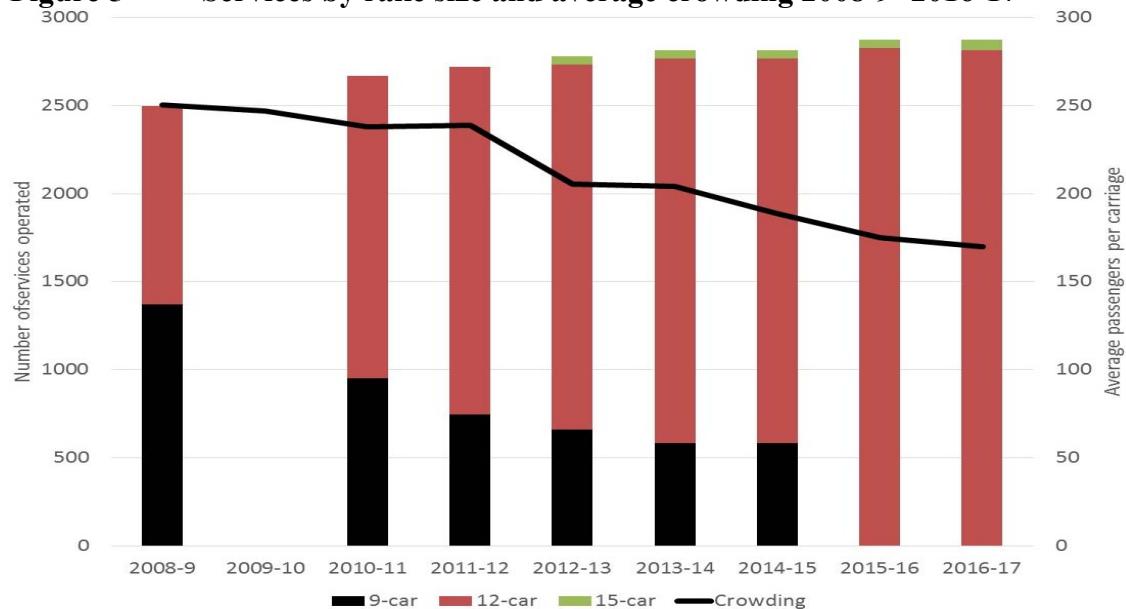
113. In June 2014, the first stage of the Mumbai Metro was opened, between Versova and Ghatkopar via Andheri. This line provides a direct link eliminating the need to travel to either Dadar or Wadala Road and change. It carried some 92 million passengers during its first year, of which an estimated 40 million transferred from the heavy rail network. Without this new line, passenger demand would have reached 85% of the appraisal estimate.

114. Passenger-km, has not slowed as much and is only 15% less than forecasts. It has been expected that the historic increase in lead (average trip length) would eventually stabilize but instead it has continued to grow, possibly also reflecting that shorter-distance passengers in some areas are increasingly looking for alternative modes because of lack of capacity.

115. Train operations have broadly kept pace, but no more, with demand. Between the initial appraisal and the start of the loan, crowding deteriorated significantly, with the forecast 213 passengers/vehicle (system average) in 2008/9 much lower than the actual

figure of 250 passengers/vehicle, largely due in delays to the arrival of the MUTP1 fleet. There has been a considerable improvement since but most improvements have been seen on CR, especially on the Harbour Line, which has been converted from all 9-car rakes in 2008/9 to all 12-car rakes at present (Figure 5). The sharp improvement in 2012-13 follows the final delivery of the MUTP1 fleet while the continuing improvement in 2015-16-17 is due to the delivery of the MUTP2A fleet.

**Figure 5 Services by rake size and average crowding 2008-9 -2016-17**



116. For the purposes of the re-evaluation, passenger demand has been assumed to continue to grow at the long-term rate of 1.6% p.a. There are a number of new Metro lines that are planned to open over the next decade but most are not competing directly with heavy rail in the same manner as the first Metro line (which eliminated both a dogleg and an interchange). The combined impact of the new lines is estimated at 1.5% of current demand and has been ignored in the re-evaluation.

### ***Economic Analysis Framework***

117. The economic analysis at appraisal used the same framework as used the project appraisal. This compares the incremental costs and benefits of the project compared to a ‘without-project’ case in which a smaller fleet operates the suburban services, thus increasing crowding and reducing demand compared to the ‘with-project’ case.

118. 72 12-car rakes had been introduced by the end of 2016/17. However, the Mumbai fleet remained more or less constant during their introduction, as the equivalent of 50 DC rakes could no longer be used in Mumbai following the final conversion to AC. Together with a further 20 rakes they were either retired or transferred to other DC suburban systems.

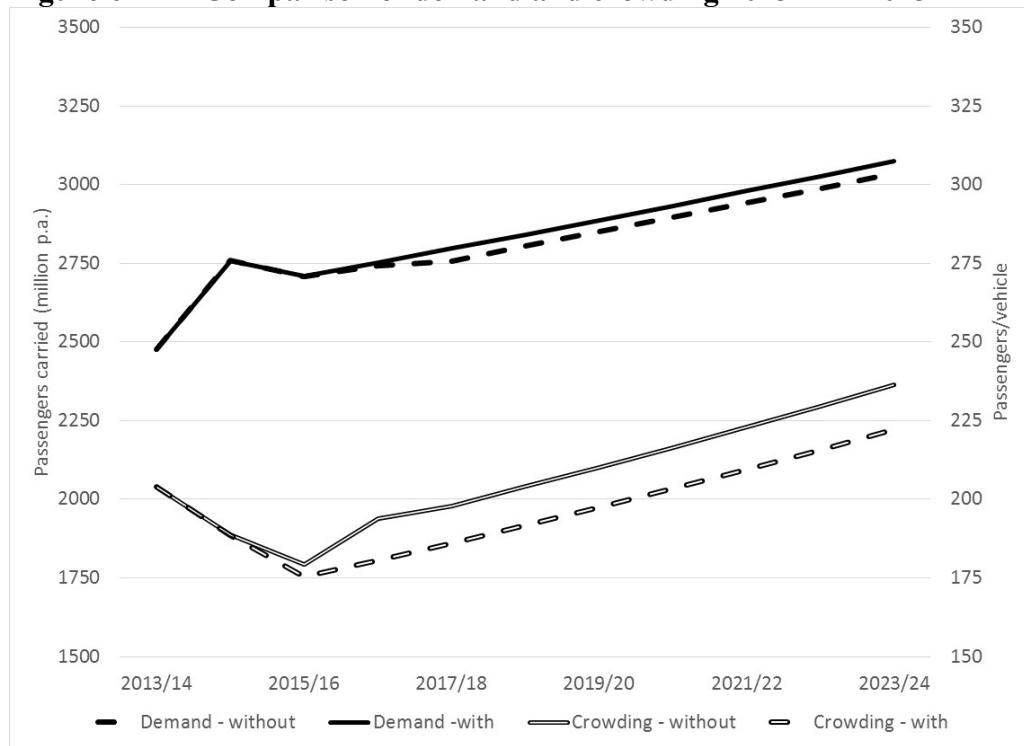
119. In the absence of the project, many of these rakes would have had to have been retired anyway but several could also have continued to operate in Mumbai. The ‘without-project’ case assumes 60% of those transferred or retired could have continued to operate in Mumbai if required.

120. As in the project appraisal, both ‘with project’ and ‘without-project’ cases assume no further rakes are introduced until 2024- seven years after the last new rakes have been delivered.

121. The reduced number of rakes available in the ‘without-project’ case creates higher crowding than in the ‘with-project’ case. This in turn dampens demand; this has been estimated using the same crowding elasticity of -0.20 (with respect to changes in passengers per vehicle) as was used in the appraisal. This was applied as an incremental change to the base demand forecast in the ‘with-project’ case.

122. The introduction of the new EMUs will also increase the average speed of the network, although not to the extent envisaged at appraisal. On an intensively-used system such as Mumbai, full advantage of the higher maximum speed of the new rakes can only be realized if they are the only rakes operating on a particular route. WR intends to do this in the near future, with the new rakes concentrated on the fast services from Virar and the other rakes operated on the stopping services. Nevertheless, this only represents about 14% of the total services on the Mumbai system and the overall impact, although locally very significant, is relatively small. Figure 6 compares the demand and crowding for the two cases.

**Figure 6 Comparison of demand and crowding 2013-14 – 2023-24**



### **Project costs**

123. These cover the capital cost of the incremental rakes, the conversion from DC to AC of the remaining network and additional maintenance facilities. Table 5 compares the cost at appraisal with the actual cost incurred.

**Table 5 Incremental capital costs (excluding trespass component)**

	(Rs crores)	US\$ (million) <sup>(1)</sup>	(Rs crores)	US\$ (million) <sup>(2)</sup>
2009-10	130	27		
2010-11	316	66	176	39
2011-12	623	130	431	89
2012-13	1127	235	278	51
2013-14	1359	283	336	56
2014-15	735	153	546	89
2015-16			1351	207
2016-17			1371	209
<b>Total</b>	<b>4290</b>	<b>894</b>	<b>4489</b>	<b>739</b>

(1) Converted at US\$1 = Rs 48

(2) Converted at actual exchange rates

124. In 2013 it became apparent that the cost of the new rakes would be substantially less in US\$ terms than had been assumed at appraisal and the loan was restructured, with US\$ 75 million reduced from the loan component of the cost of the rakes. Of this \$30 million was reassigned to a new component dealing with reducing trespass on the network (this includes unauthorized crossing of tracks at stations) and US \$45 million was cancelled. Table 5 excludes the cost of the trespass component

125. The financial costs have been converted into economic costs using a conversion factor of 0.9. For the purposes of the economic analysis, terminal values of the assets have been based on the remaining lives of the assets in the final year of the analysis.

### **Project benefits**

126. At appraisal these included the following:

- (i) The reduction in crowding will reduce travel discomfort for passengers. This was originally valued at Rs.3.5 per hour (2001 prices) in the economic analysis of MUTP-1, based on stated preference surveys undertaken as part of project preparation. This was updated to Rs 14.08 at 2017 prices, after allowing for the increase in average incomes since the original survey.
- (ii) Savings in time due to (i) reduced journey time due to the higher maximum speed of the new AC sets (100 km/hr compared to 80 km/hr for the previous sets), and (ii) reduced waiting time due to increase in the frequency of trains once rakes are put into service. Journey time savings accounted for 48 percent of economic savings. The current evaluation does not include benefits from waiting time savings, as these would be relatively small at peak periods (if they were included at the conventional value of twice in-vehicle time, they would increase total net benefits by over 40 percent). The value of time was derived in the CTS study as Rs.25.00 per hour (2006 prices). This was updated to Rs.27.50 per hour for the base year (2008) and increased to Rs 73 (2017 prices) to reflect inflation and increases in per capita income. The CTS estimates were derived by transportation mode, based on household characteristics (including trip frequency and household income) recorded in the household survey.

- (iii) The improved level of service is forecast to generate additional demand in the Project Case compared to the Base Case. The benefits for these passengers have been estimated using the ‘rule of half’.
- (iv) Some of these passengers will be diverted from other modes. Diversion from car has been neglected but 20 percent of the additional patronage has been assumed to come from bus. This reduction in bus patronage will enable service levels to be adjusted (assuming an average bus occupancy of 54 passengers/bus), leading to a reduction in bus operating costs. These were estimated in the 2008 BEST business plan at Rs.45.60 per km (2008 prices) and this has been updated to Rs 67 per km for 2017.
- (v) The additional trains operated with the project generate increased operating costs although this has been partially offset by the reduced electricity consumption once the entire system was converted to AC. This provides the opportunity for regeneration by generating electricity back into the system during braking and reduces electricity consumption by about 35%. The project converted three sections of track: CSTM to Thane, CSTM to Tilaknagar and Mahim to Wadala Road. In 2017, these three sections represented about 29% of the total traction energy used in the system.
- (vi) The reduction in bus operations will also contribute to reduced pollution and road congestion. While the Mumbai EMU services generate very limited pollutants locally, buses emit NO<sub>2</sub> and SO<sub>2</sub> at an estimated rate of 0.25 kg per bus hour. The direct benefit was estimated at Rs.175 per passenger per annum (2001 prices) in the MUTP-1 analysis; this has been updated to Rs.240 in 2008 prices and Rs 550 in 2017 prices. Indirect benefits from reduced pollution arise to the population living along the road corridor and were estimated at Rs.5.5 per ton (2008 prices), updated to Rs 12.50 (2017 prices). Road congestion benefits, estimated at Rs 0.07 per passenger-km averaged over the day are negligible.

#### ***Economic Rate of Return***

127. The benefits are calculated for the 25-year period following project completion, from 2017 to 2042 and the estimated EIRR derived and NPV calculated (using a discount rate of 12 percent). The estimated NPV, discounted to 2012, is about US\$515 million in 2017 prices with an EIRR of 20 percent. The summary of benefits is shown in Table 6 and compared to the appraisal result. Table 7 gives the forecast cash flows.

**Table 6****Present value of project benefits (discounted at 12 percent)**

	<i>Total (\$US million)</i>	
	<i>Appraisal<sup>(1)</sup></i>	<i>ICR<sup>(2)</sup></i>
<b><i>Costs</i></b>		
Capital expenditure	-501	-487
Additional operating cost	-1122	-74
<i>Subtotal:</i>	<b>-1623</b>	<b>-524</b>
<b><i>User benefits</i></b>		
Reduced waiting time	37	206
Reduced crowding	915	384
Reduced journey time	613	325
Benefits to diverted passengers	80	4
<i>Subtotal:</i>	<b>1645</b>	<b>919</b>
<b><i>Bus-related benefits</i></b>		
Reduced operating costs	178	92
Pollution benefits	77	37
<i>Subtotal:</i>	<b>255</b>	<b>129</b>
<b><i>GHG benefits</i></b>	n.a.	2
<b>NPV</b>	<b>262</b>	<b>515</b>

(1) US\$ 2008 discounted to 2010

(2) US\$ 2017 discounted to 2012

128. The largest discrepancy is the estimated additional rail operating cost. The appraisal forecast a difference in vehicle-km between the with-project and without-project that was four times larger than that assumed in the re-evaluation. The appraisal also estimated the marginal cost of the additional rail operations which was nearly three times larger than that used in the appraisal; the principal reason for this was the inclusion of both infrastructure costs (which in the re-evaluation have been assumed to be largely fixed) and more general costs which are essentially an allocation of general management. The costs used in the re-appraisal are based on a detailed analysis of 2014/15 expenditure and represent the avoidable ‘above-rail’ cost of additional operations.

129. The differences in waiting time savings are caused by a very conservative assumption of the time saved per passenger in the original appraisal combined with a higher valuation of waiting time in the re-appraisal and double in-vehicle time, consistent with most observed values).

130. The reduced crowding benefits in the re-appraisal are a direct result of the reduction in vehicle-km compared to the original and the reduced journey time savings are due to a more stringent assessment of the benefits based on current operating strategies.

**Table 7      MUTP-2A Forecast Economic Returns**

(In crores of Rupees 2017)

Year	Capital Investment in MUTP-2A	Incremental Operating Cost	Waiting time	Comfort	Journey time	Bus VOC	Direct pollution	Indirect pollution	GHG	Diverted passengers	Net Benefits
2010-11	-232		0	0	0	0	0	0		0	-232
2011-12	-527	0	0	0	0	0	0	0		0	-527
2012-13	-309	0	0	0	0	0	0	0		0	-309
2013-14	-339	0	0	0	0	0	0	0		0	-339
2014-15	-526	0	0	0	0	0	0	0		0	-526
2015-16	-1265	-44	105	84	0	62	0	25	2	0	-1031
2016-17	-1234	-91	222	296	0	73	0	29	1	1	-703
2017-18		-91	224	272	0	99	1	40	2	2	548
2018-19		-91	228	351	400	97	0	39	2	5	1031
2019-20		-91	231	383	425	101	0	41	2	5	1097
2020-21		-91	235	421	451	104	1	42	2	5	1169
2021-22		-91	239	462	478	107	1	43	3	6	1246
2022-23		-91	243	507	507	110	1	44	3	6	1329
2023-24		-91	247	556	538	113	0	46	3	7	1419
2024-25		-91	254	573	538	117	0	47	3	7	1448
2025-26		-91	262	590	554	120	0	48	3	7	1494
2026-27		-91	269	608	571	124	1	50	3	7	1541
2027-28		-91	277	626	588	128	1	51	4	7	1590
2028-29		-91	286	645	605	132	1	53	4	7	1641
2029-30		-91	294	664	624	135	1	54	4	8	1693
2030-31		-91	303	684	642	140	1	56	4	8	1746
2031-32		-91	312	704	662	144	1	58	4	8	1801
2032-33		-91	322	726	681	148	1	60	4	8	1858
2033-34		-91	331	747	702	152	1	61	4	9	1917
2034-35		-91	341	770	723	157	1	63	5	9	1977
2035-36		-91	351	793	745	162	1	65	5	9	2039
2036-37		-91	362	817	723	167	1	67	5	9	2058
2037-38		-91	373	841	790	172	1	69	5	9	2168
2038-39		-91	384	866	814	177	1	71	5	10	2237
2039-40		-91	396	892	838	182	1	73	6	10	2307
2040-41		-91	407	919	863	188	1	75	6	11	2379
2041-42	1930	-91	420	947	889	193	1	78	6	11	4382

ERR      20%

## Annex 4. Bank Lending and Implementation Support/Supervision Processes

**Table 8 Task Team members**

<b>Names</b>	<b>Title</b>	<b>Unit</b>	<b>Responsibility/ Specialty</b>
<b>Lending</b>			
Hubert Nove-Josserand	Sr. Urban Transport Spec. / TTL	SASDT	Transport
Atul Agarwal	Transport Specialist	SASDT	Transport
Ramola Bhuyan	Sr. Financial Mgmt. Spec.	SARFM	FM
Satya N. Mishra	Social Development Spec.	SASDS	Social
Manmohan Singh Bajaj	Senior Procurement Specialist	SARPS	Procurement
Abduljabbar H. Al Qathab	Senior Procurement Specialist	SARPS	Procurement
Gaurav D. Joshi	Environmental Specialist	SASDI	Environment
Vasile Olievschi	Sr. Railway Specialist	ECSS5	Railways
Gennady Pilch	Sr. Counsel	LEGES	Legal
David Freese	Sr. Finance Officer	CTRFC	FM
Krishnan Srinivasan	Consultant	SASDT	Transport
Jitendra Sondhi	Consultant	SASDT	Transport
Ed Dotson	Consultant	SASDT	Transport
Alok Nath Bansal	Consultant	SASDT	Transport
Richard G. Bullock	Consultant	SASDT	Transport
Jorge M. Rebelo	Lead Transport Spec./Peer Reviewer	LCSTR	Transport
John Scales	Lead Transport Spec./Peer Reviewer	EASCS	Transport
Shomik Raj Mehndiratta	Sr. Transport. Spec./Peer Reviewer	EASCS	Transport
Radia Benamghar	Operations Analyst	SASDT	Transport
Natalya Stankevich	Operations Analyst	SASDT	Transport
Gizella Diaz	Program Assistant	SASDO	Transport
Ritu Sharma	Program Assistant	SASDO	Transport
<b>Supervision/ICR</b>			
Atul Agarwal	Sr Transport. Specialist / TTL	GTI06	Transport
Manmohan Singh Bajaj	Consultant	GTI06	Transport
Rakhi Basu	Transport Specialist	GTI06	Transport
Gizella Diaz Munoz	Program Assistant	GFA12	Transport
Priya Goel	Sr Financial Management Specialist	SARFM – HIS	FM
Gaurav D. Joshi	Senior Environmental Specialist	GEN06	Transport
Satya N. Mishra	Social Development Specialist	GSU06	Social
Sudip Mozumder	Principal Communications Officer	SAREC	Communications
Hubert Nove-Josserand	Operations Adviser	SACIN	Transport
I. U. B. Reddy	Senior Social Development Specialist	GSU06	Social
Ritu Sharma	Program Assistant	SACIN	Transport
Dominic Patella	Sr. Transport. Specialist / ICR TTL	GT106	Transport
Paul Kaiser	Consultant	GTI06	ICR

**Table 9 Staff Time and Cost**

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD Thousands (including travel and consultant costs)
<b><i>Lending</i></b>		
FY09	19.98	160.53
FY10	73.03	316.88
<i>Subtotal (lending):</i>	<b>93.01</b>	<b>447.41</b>
<b><i>Supervision/ICR</i></b>		
FY11	19.38	82.14
FY12	43.18	192.07
FY13	54.74	195.84
FY14	42	255.38
FY15	26.98	129.04
FY16	32.12	197.88
FY17	11.97	105.82
<i>Subtotal (supervision/ICR):</i>	<b>230.37</b>	<b>1,158.17</b>
<b>Total (all stages)</b>	<b>323.38</b>	<b>1,635.58</b>

## **Annex 5.      Beneficiary Survey Results**

131. MRVC commissioned a third party to survey commuter passengers on the amenities provided in the twelve-car rakes developed and commissioned into service with MUTP-2A financing.

132. 1,500 first and second class passengers were surveyed by the firm Storytellers from March 16-20, 2016. Passengers were asked about the following characteristics of the newly designed train compartments:

- (i) Seating pattern;
- (ii) Leg space;
- (iii) Visibility of passenger information system;
- (iv) Ventilation system;
- (v) Electrical fittings, handles for standing passengers;
- (vi) Height and width of luggage rack;
- (vii) Window size;
- (viii) Center pole for boarding and alighting; and the
- (ix) Width of first and second class seating.

133. The overall satisfaction with these amenities 87.08%, with the lowest favorable rating 82% and the highest rating 92%. Results of the survey, titled “Passenger Survey of new age ICF manufactured MUTP PH-II EMU rakes with M/s. Bombardier Electrics (2015)” are available on MRVC’s website at:

[http://www.mrvc.indianrailways.gov.in/view\\_section.jsp?lang=0&id=0,295,483](http://www.mrvc.indianrailways.gov.in/view_section.jsp?lang=0&id=0,295,483)

## **Annex 6. Stakeholder Workshop Report and Results**

n/a

## **Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR**

### ***Summary and overall assessment***

134. As part of Comprehensive Transport Plan for Mumbai Metropolitan Region, a multi modal Mumbai Urban Transport Project (MUTP) Phase I comprising of both road and rail components was sanctioned in 2003-04. The rail component has been completed at a total cost of around Rs. 4,452 crores including a World Bank loan of Rs. 1,600 crores in 2012. Under MUTP Phase I, 35% additional carrying capacity was augmented by way of converting 9-coach trains to 12-coach trains and running of 559 additional train services. To run longer trains and additional train services, 1500V DC traction system on Western Railway and Central Railway (up to Thane) was converted to 25 kV AC under MUTP Phase I. Also, with the introduction of new technology 3-phase EMU coaches with regenerative braking, there was an energy saving of 35% in the suburban system.

135. During the preparation of Mumbai Urban Transport Project (MUTP), the long-term requirements for the development of urban transport in Mumbai were discussed and evaluated. It was decided to include the Rail Projects that were urgently required in the ongoing MUTP Phase I. It was decided that there would be a second phase of MUTP to realize the full benefits of MUTP Phase I as well as to create additional capacities for urban transport to meet the increasing demand in the metropolitan region.

136. Subsequently, MUTP Phase II was sanctioned in the Railway Budget 2008-09 at a total cost of Rs. 5,300 crore. MUTP Phase II has been bifurcated in two parts i.e. MUTP-2A and MUTP-2B. MUTP-2A intends to realize the full capacity of the infrastructure network existing as a result of MUTP Phase I. MUTP 2B also create additional infrastructure requiring land acquisition and resettlement. MUTP 2A is partly funded by World Bank loan and balance by Counter Part funding while MUTP 2B is completely funded by Counter Part funds.

The following works constructed under MUTP 2A

- (i) Procurement of 864 EMU coaches
- (ii) DC to AC Conversion
- (iii) EMU maintenance facilities & EMU stabling lines
- (iv) Technical Assistance including works on trespass control measures

137. The original IBRD loan was USD 430 million at the time of signing which has been revised to USD 309 million after last restructuring took place in February 2016. The loan amount was reduced from time to time because of saving in contract for procurement of EMU electrics due to competitive prices obtained and depreciation of US Dollar against Rupee etc.

138. MUTP 2A aims at maximizing the utilization of the suburban rail system on the infrastructure that has been created under MUTP including the infrastructure created by Indian Railways with their own resources. It includes procurement of 72 additional twelve-car EMU rakes (864 coaches), completion of conversion from 1500V DC to 25000V AC traction on the remaining sections of Central Railway and expansion of maintenance

facilities and provision of stabling lines for the additional EMU rakes included in the project. Some technical assistance studies have also been included in the project. Trespassing control measures at various suburban stations of Mumbai is also included as Component 4 at the time of restructuring on 08.05.2015.

#### ***MRVC's evaluation of Bank performance at preparation***

139. There has been continuous and effective communication and coordination with WB which helped in preparing the implementation manual and other documents required for the project.

140. WB has also provided technical support and shared the knowledge on the Global practices which was required and necessary for technical specification and bidding documents.

141. The Task Team Leader and all other Members of World Bank during appraisal missions had been supported at all the times.

#### ***MRVC's evaluation of Bank performance during implementation***

142. World Bank has helped in finalization of contracts by providing guidance from time to time. World Bank team used to meet Ministry of Railways, Govt. of Maharashtra or other Stakeholders for apprising the status of the project, timely resolution of any issue, etc.

143. World Bank has always been active in conveying timely No Objections during the bidding stage and contract execution. Further, there has been timely disbursement of the loan by WB as per the agreed timelines.

144. World Bank has also provided technical support and guidance during the execution and implementation of the project. The various Workshops on Station Redevelopment, Communication Based Train Control System (CBTC) on 02.07.2015, 03.07.2015, 17.02.2016 & various Seminars on 20.02.2013, 07.11.2013, 05.11.2014, 20.11.2015, were conducted with the support of World Bank. This resulted in the enhancement of the knowledge in technology and exposure to the Global Practices for Officials of Ministry of Railways and GoM.

#### ***Lessons learned***

##### ***Mandatory provisions of Environmental Management (EMP)***

145. In all MRVC contracts, it is mandatory to follow the Environmental Management Plan (EMP) and an EIA (Environmental Impact Assessment) of the project is done, which takes up environmental issues such as health and hygiene at labour camps, safety regulations for labour/public, pollution controls. This results in adoption of better construction practices.

##### ***Compensation for delayed bill payments***

146. As per contract conditions, if the Employer makes a late payment, the Contractor shall be paid interest on the late payment. In MRVC, both executive and finance teams

work hard to make timely payments of bills and the bill position is uploaded on website. To date, there has not been a single instance of contractor claiming interest charges for delayed payment.

*Penalty clause under consultancy contracts*

147. There is no clause of penalty for non-performance, replacing the key-personnel, no active participation by JV partners, delay etc. by the Consultant. It is suggested that the clause on penalty should be suitably incorporated in the consultancy contracts.

- (i) Adoption of World Bank procurement procedure which are based on Global best practices & unique salient features such as balanced bid document, transparency, Dispute resolving mechanism etc.
- (ii) Uniform Procurement Policy adopted in line with World Bank guidelines
- (iii) Assurance of funds from State & Central Government due to the commitments with WB
- (iv) Environmental mitigation measures are now part of bidding documents
- (v) Implementation of well-defined social and environmental mitigation measures

*Recommendations for future engagements*

148. Urban Transport in Mumbai benefited with engagement of World Bank and continuous engagement will further benefit the City for improving the Urban Transport and hence economic development of the City

**Annex 8.      Comments of Cofinanciers and Other Partners/Stakeholders**

n/a

## **Annex 9. List of Supporting Documents**

Aide Memoires

November 20-23, 2012  
June 17-21, July 3 and 31, 2013 (Mid-Term Review)  
October 7-11, 2013  
March 24-27, 2014  
July 7-8, 2014  
September 1-5 and 18-19, 2014  
February 23-27 and March 5, 2015  
June 3-5, 2015  
August 10-14, 2015  
February 15-19, 2016  
August 1-6, 2016  
November 28-December 2, 2016

Auditors Report, Financial Years 2011-2012, 2013-14, 2015-16

Government of India, 12th Five-Year Plan (FY2013-17)

Implementation Status and Results (ISR) Reports

Sequence 1, 3-14

Mumbai Railway Vikas Corporation, Challenges in Execution of Trespass Control Works

Mumbai Railway Vikas Corporation, Customer Satisfaction Survey, conducted by Storytellers, March 16-20, 2016

Mumbai Railways Vikas Corporation. Environment and Social Management Plan, Mumbai Railway Vikas Corporation, Status Report for Mid Term Review, June 2013

MUTP-2A – June 2013 – Financial Management

MUTP-2A – November 2012 – Financial Management

Project Appraisal Document on a Proposed Loan in the Amount of US\$430 Million to the Republic of India for a Mumba Urban Transport Project – 2A, June 2, 2010, Report No. 54171-IN

Project Performance Assessment Report, India, Mumbai Urban Transport Project (IBRD-46650 and IDA-36620), June 15, 2016

Restructuring Papers, August 4, 2011(Report No. 63374-IN), May 8, 2013 (Report No. 77376-IN), October 9, 2014 (Report No. 13216), March 7, 2016 (Report No. 22792)

Social Management Framework for MUTP-2A

World Bank, India - Country Partnership Strategy for the Period FY13-FY17, March 21, 2013 (Report No. 76176)

