

Document of
The World Bank
FOR OFFICIAL USE ONLY

Report No: ICR00002575

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(BR-7869)
ON AN IBRD LOAN OF
US\$130 MILLION
TO THE
SAO PAULO SECRETARIAT OF METROPOLITAN TRANSPORT
FOR THE
SÃO PAULO METRO LINE 4 (PHASE 2) (P106390)
November 16, 2018

Transport Global Practice
Latin America and Caribbean Region

CURRENCY EQUIVALENTS
(Exchange Rate Effective November 11, 2018)

Currency Unit = Brazilian Real (BRL)

BRL 3.73 = US\$1

US\$1.392 = SDR 1

FISCAL YEAR
July 1 - June 30

Regional Vice President: Jorge Familiar

Country Director: Martin Raiser

Senior Global Practice Director: Guangzhe Chen

Practice Manager: Juan Gaviria

Task Team Leader(s): Bianca Bianchi Alves, Gregoire Francois Gauthier

ICR Main Contributor: Nathalie Picarelli

ABBREVIATIONS AND ACRONYMS

CBTU	<i>Companhia Brasileira de Transportes Urbanos</i>
CDTI	Integrated Transport Coordination Committee, Comitê Diretor de Transporte Integrado
CPF	Country Partnership Framework
CPS	Country Partnership Strategy
CPTM	<i>Companhia Paulista de Trens Metropolitanos</i>
CVQ	ViaQuatro Concessionaire
DD	Detailed Design
EA	Economic Analysis
EIRR	Economic Internal Rate of Return
EMTU	<i>Empresa Metropolitana de Transportes Urbanos de São Paulo</i>
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IBGE	<i>Instituto Brasileiro de Geografia e Estatística</i>
ICB	International Competitive Bidding
ICR	Implementation Completion and Results Report
IE	Impact Evaluation
JBIC	Japan Bank for International Cooperation
M&E	Monitoring and Evaluation
MTA	Metropolitan Transit Authority
NPV	Net Present Value
OD	Origin and Destination
O&M	Operation and Maintenance
PAD	Project Appraisal Document
PDO	Project Development Objective
PITU	Integrated Urban Transport Plan
PMOC	Project Management Oversight Consultant
PMU	Project Management Unit
PPP	Public-Private Partnership
RP	Restructuring Paper
RTCC	Regional Thematic Council
SPMR	Sao Paulo Metropolitan Region
SSP	State of Sao Paulo
STMSP	<i>Secretaria de Transportes Metropolitanos do Estado de Sao Paulo</i>

TABLE OF CONTENTS

DATA SHEET	ERROR! BOOKMARK NOT DEFINED.
I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES.....	5
A. CONTEXT AT APPRAISAL	5
B. SIGNIFICANT CHANGES DURING IMPLEMENTATION	12
II. OUTCOME	16
A. RELEVANCE OF PDOs	16
C. EFFICIENCY.....	23
D. JUSTIFICATION OF OVERALL OUTCOME RATING.....	25
E. OTHER OUTCOMES AND IMPACTS	25
III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME.....	28
A. KEY FACTORS DURING PREPARATION	28
B. KEY FACTORS DURING IMPLEMENTATION	29
IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME ..	31
A. QUALITY OF MONITORING AND EVALUATION (M&E)	31
B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE	33
C. BANK PERFORMANCE	33
D. RISK TO DEVELOPMENT OUTCOME	36
V. LESSONS AND RECOMMENDATIONS	36
ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS.....	39
ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION.....	47
ANNEX 3. TOTAL PROJECT COST BY COMPONENT	49
ANNEX 4. EFFICIENCY ANALYSIS.....	51
ANNEX 5. SUPPORTING DOCUMENTS	56
ANNEX 6. PROJECT TIMELINE OF KEY EVENTS.....	57



DATA SHEET

BASIC INFORMATION

Product Information

Project ID	Project Name
P106390	Sao Paulo Metro Line 4 (PHASE 2)
Country	Financing Instrument
Brazil	Investment Project Financing
Original EA Category	Revised EA Category
Full Assessment (A)	Full Assessment (A)

Organizations

Borrower	Implementing Agency
Sao Paulo Secretariat of Metropolitan Transport	SAO PAULO METRO

Project Development Objective (PDO)

Original PDO

The objective is to improve the quality of service provided to the urban transport users in the area of influence of the new Line 4 stations and facilitate the integration between metro and bus at those stations.

Revised PDO

The objective is to improve the quality of service provided to the urban transport users in the area of influence of the new Line 4 stations and facilitate the integration between metro and bus at those stations.

PDO as stated in the legal agreement

The Project Development Objectives are: (a) to improve the quality of service provided to the urban transport users in the area of influence of the new Line 4 stations (São Paulo-Morumbi, Fradique Coutinho, Oscar Freire, Higienópolis-Mackenzie and Vila Sônia); (b) and to facilitate the integration between metro and bus at those stations



FINANCING

	Original Amount (US\$)	Revised Amount (US\$)	Actual Disbursed (US\$)
World Bank Financing			
IBRD-78690	130,000,000	130,000,000	130,000,000
Total	130,000,000	130,000,000	130,000,000
Non-World Bank Financing			
Borrower	340,900,000	369,056,000	95,835,000
JAPAN: Japan Bank for Internaitonal Cooperation (JBIC)	130,000,000	130,000,000	130,000,000
Total	470,900,000	499,056,000	225,835,000
Total Project Cost	600,900,000	629,056,000	355,835,000

KEY DATES

Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
04-May-2010	15-Dec-2010	22-Mar-2013	30-Jun-2014	28-Feb-2018

RESTRUCTURING AND/OR ADDITIONAL FINANCING

Date(s)	Amount Disbursed (US\$M)	Key Revisions
28-May-2014	39.61	Change in Loan Closing Date(s)
29-Apr-2016	84.13	Change in Results Framework Change in Loan Closing Date(s) Change in Procurement Change in Implementation Schedule

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Moderately Satisfactory	Satisfactory	Modest



RATINGS OF PROJECT PERFORMANCE IN ISRs

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US\$M)
01	07-Jun-2010	Moderately Satisfactory	Moderately Satisfactory	0
02	21-Dec-2010	Moderately Satisfactory	Moderately Satisfactory	0
03	28-Jun-2011	Moderately Satisfactory	Moderately Unsatisfactory	0
04	13-Dec-2011	Moderately Satisfactory	Moderately Unsatisfactory	0
05	20-Jun-2012	Moderately Satisfactory	Moderately Satisfactory	0
06	09-Jan-2013	Satisfactory	Moderately Satisfactory	25.32
07	12-Dec-2013	Moderately Satisfactory	Moderately Unsatisfactory	53.50
08	25-May-2014	Moderately Satisfactory	Moderately Satisfactory	76.15
09	12-Dec-2014	Moderately Satisfactory	Moderately Satisfactory	108.52
10	03-Apr-2015	Moderately Satisfactory	Unsatisfactory	109.52
11	11-Sep-2015	Moderately Satisfactory	Unsatisfactory	114.53
12	04-Nov-2015	Moderately Satisfactory	Moderately Satisfactory	117.53
13	08-Jun-2016	Moderately Satisfactory	Moderately Satisfactory	148.40
14	28-Nov-2016	Moderately Satisfactory	Moderately Satisfactory	148.40
15	09-Jun-2017	Moderately Satisfactory	Moderately Satisfactory	188.97
16	27-Dec-2017	Moderately Satisfactory	Moderately Satisfactory	240.78
17	28-Feb-2018	Moderately Satisfactory	Moderately Satisfactory	259.72

SECTORS AND THEMES

Sectors

Major Sector/Sector	(%)
Transportation	100
Urban Transport	49
Public Administration - Transportation	6
Railways	45

**Themes**

Major Theme/ Theme (Level 2)/ Theme (Level 3)	(%)
Private Sector Development	10
Public Private Partnerships	10
Urban and Rural Development	99
Urban Development	99
Urban Infrastructure and Service Delivery	99
Environment and Natural Resource Management	0
Environmental Health and Pollution Management	0
Air quality management	0
Water Pollution	0
Soil Pollution	0

ADM STAFF

Role	At Approval	At ICR
Regional Vice President:	Pamela Cox	Jorge Familiar Calderon
Country Director:	Makhtar Diop	Martin Raiser
Senior Global Practice Director:	Laura Tuck	Guangzhe Chen
Practice Manager:	Aurelio Menendez	Juan Gaviria
Task Team Leader(s):	Jorge M. Rebelo	Bianca Bianchi Alves, Gregoire Francois Gauthier
ICR Contributing Author:		Nathalie Picarelli



I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

Country Context

1. **At appraisal, the Sao Paulo Metropolitan Region (SPMR) had the highest population density in Brazil, facing severe challenges related to uncontrolled urban sprawl.** The SPMR comprised 39 municipalities and had close to 19 million inhabitants in 2010 (IBGE).¹ It generated more than 20 percent of Brazil's gross domestic product (GDP) and despite facing economic decline since the 1990s, it was the most important economic region in the country. Rapid urbanization had resulted in uncontrolled urban sprawl, with associated traffic congestion and increased travel distances; social problems such as crime and unemployment exacerbated inequalities. In 2004, unemployment was 5 percentage points higher in the SPMR than the national average (at 14 percent).² Out of the 49 metropolitan regions of Brazil, the SPMR had the highest population density and held the fourth and fifth highest share of the population living in slums (9 percent) and informal housing (16 percent), respectively.³

2. **Increased motorization had resulted in large negative externalities including pollution, accidents, and long commuting times; the lack of integration of the public transport sector was one of the main constraints.** The modal split in the SPMR showed important trends toward increased motorization. About 37 percent of the daily commuting trips took place by car, with only 30.8 percent by public transport modes and the rest by foot. Of the 12 million daily trips taken by public transport mode, about one-third of passengers used more than one mode or required a transfer, reflecting the need for the integration of the public transport sector both physically and tariff-wise. At the time, 78 percent of all metro trips required one or more transfers to be completed. The main public transport mode used was buses, which accounted for close to 75 percent of all public transport trips; the second was metro with close to 15 percent of all public mode trips and the remainder was suburban rail. This had led to an overreliance on road-based modes, which contributed to heavy congestion, pollution, and road accidents. For example, vehicles accounted for 73 percent to 94 percent of most air pollutants in the SPMR and contributed to 31 percent of particulate matter emissions. In 2006, there were about 150,000 road accidents in the SPMR with a cost conservatively estimated at US\$1.5 million per day. The cost of congestion had been estimated at US\$6 million per day (SPMR Traffic Engineering Department).⁴

3. **Low-income households were penalized the most by the lack of adequate public transport.** Low-income urban households as the main users of public transport (figure 1) suffered the cost of its low quality. According to the Origin and Destination (OD) Survey 2007, a large proportion of trips toward central areas originated in peripheral suburban zones where poorer households lived⁵ (figure 2). Poor households were faced with (a) extreme overcrowding of trains (more than 8 passengers per square

¹ Instituto Brasileiro de Geografia e Estatística.

² IBGE.

³ World Bank. 2007. "Brazil Sao Paulo: Inputs for a Sustainable Competitive City Strategy."

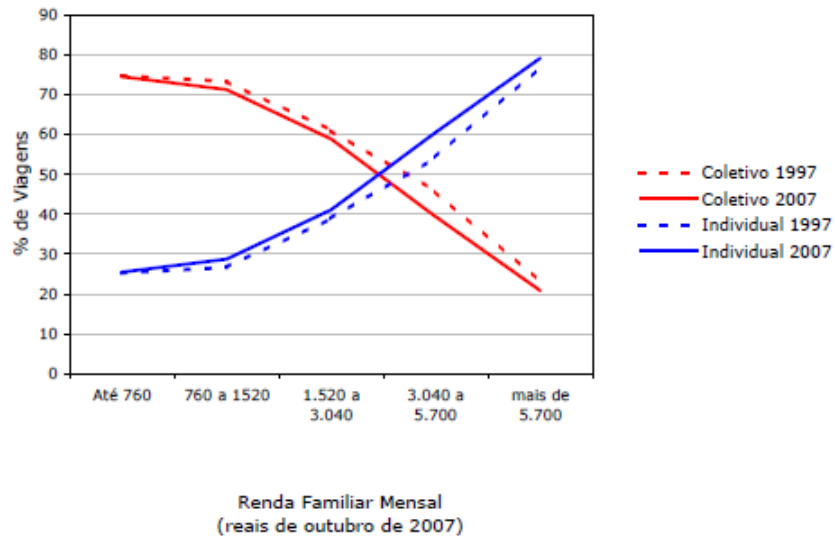
⁴ Project Appraisal Document (PAD), Metro Line 4 Project (P106390).

⁵ Haddad, E. A., N. L. Gracia, E. Germani, R. S. Vieira, A. I. Aguilera, B. B. Alves, and E. Skoufias. 2018. *Mobility in Cities: Distributional Impact Analysis of Transportation Improvement in Sao Paulo Metropolitan Region* (No. 2018_11). University of São Paulo (FEA-USP).



meter) due to shortage of capacity at peak hours, (b) long commuting journeys (2.5 hours a day from the metropolitan periphery to the urban centers) with often more than two modal transfers, and (c) high costs for transport resulting in the need to spend as much as 20 percent of income toward fares, particularly for informal workers who did not receive a transport subsidy.⁶

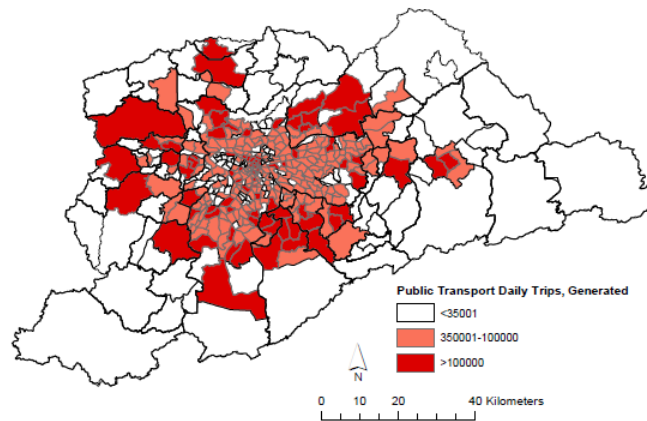
Figure 1. Total Daily Motorized Trips in the SPMR by Household Income (1997 and 2007)



Source: Sintese OD Survey 2007, Metro.

Note: The y-axis represents the percentage of daily motorized trips (for example, motorbike, cars, bus, metro) and the x-axis represents bins of monthly household income from lowest to highest; the red and blue lines are for individual and public transport respectively; the dashed line is 1997 data; the solid line is 2007.

Figure 2. Origin of Daily Trips by Public Transport in the SPMR (2007)



Source: OD Survey 2007.

⁶ PAD of the project.



Sectoral Context

4. **The State of Sao Paulo (SSP) had been carrying a large integration effort of the public transport system with the World Bank's support since the late 1980s.** In 1988, the Constitution assigned the responsibility of urban and metropolitan transport to the local state and municipal authorities. A process of decentralization of the federally owned and operated suburban rail system (known as *Companhia Brasileira de Transportes Urbanos* [CBTU]) to the state was completed with World Bank support in the following years (box 1). To continue this work, the SSP requested the World Bank's support to link the CBTU system to its existing suburban rail system (Ferrovia Paulista S.A [FEPASA]) and create a new subway line (Metro Line 4) to connect the expanding suburban rail system with the existing small subway network.⁷ The World Bank was requested to support these integration efforts. The first World Bank loan was approved in 1998 to finance the first part of the request: the Sao Paulo Integrated Urban Transport Project (Barra Funda-Roosevelt link) (P006559). The second World Bank loan was approved in 2002 to finance the second part: the Sao Paulo Metro Line 4 Project Phase 1 (P051696).

Box 1. Decentralization of the CBTU in Sao Paulo and Institutional Framework

In 1988, the Constitution assigned responsibility of urban and metropolitan transport to the local state and municipal authorities. A process of decentralization of the federally owned and operated suburban rail system (known as CBTU) then started. The SSP received the CBTU rail network spread throughout the SPMR from the Federal Government and faced major challenges in integrating the system with other already existing public transport modes. As part of this process, with support from the World Bank, the state prepared a long-term metropolitan transport strategy, part of the Integrated Urban Transport Plan (PITU), anchored in four pillars:

1. The establishment of a regional transport coordination commission with the municipalities, operators, and users;
2. The implementation of an integrated land use, urban transport, and air quality strategy;
3. The development of financing mechanisms which would guarantee the long-term sustainability of SPMR's urban transport system; and
4. The progressive participation of the private sector in the investment and operational management of the systems.

This World Bank-supported process played an important role in allowing for the decentralization and modernization of the CBTU to the state and laid the foundation for metropolitan coordination and the implementation of the long-term strategy. As a result, two main bodies became responsible for overseeing the metropolitan and urban transport sector in the SPMR—which remains until today: (a) the *Secretaria de Transportes Metropolitanos do Estado de Sao Paulo* (STMSP) created in 1991 and (b) the *Secretaria de Transportes da Prefeitura do Municipio de Sao Paulo*. The STMSP is responsible for urban transport in the metropolitan region outside the jurisdiction of Sao Paulo Municipality and oversees the Sao Paulo Metro, the suburban railway (the *Companhia Paulista de Trens Metropolitanos*, CPTM), and the metropolitan bus company (*Empresa Metropolitana de Transportes Urbanos de Sao Paulo*, EMTU). Therefore, the whole rail-based network of the SPMR is under the STMSP along with the intermunicipal buses. The municipal counterpart is responsible for all the buses that operate in the Sao Paulo Municipality. At appraisal—and at present—there was no regulatory agency in the SPMR either at the municipality or state level.

⁷ Sao Paulo's rail system includes both the subway and the suburban rail network (CPTM) - see box 1.



5. **The Sao Paulo Metro Line 4 was a priority undertaking within the PITU⁸ developed in the early 1990s.** The main objective of the new metro line was to support the integration efforts of the urban transport sector in the SPMR by interconnecting the existing subway, suburban rail, and bus networks through Line 4. More precisely, the line would serve to (a) connect all three existing metro lines (Lines 1, 2, 3) and Line 5 that was under construction to move from the existing radial configuration to a network configuration; (b) connect three CPTM suburban rail lines (its West line and two at Luz station), and (c) favor integration with the bus network. Metro Line 4 was designed as a transforming metro line (12.8 km and 11 stations) that would integrate these three public transport modes. Given that the SSP lacked indebtedness capacity in 2002, its construction was divided into two phases. Phase 1 during which at least 5 of 11 stations would be fully completed and Phase 2, financed under this loan (P106390), which would complete the line.

Project Context

6. **The World Bank was to provide support to Sao Paulo Metro Line 4 in two phases. Phase 1 of Metro Line 4 (P051696) started in 2002 and closed in 2010; it was to be followed by Phase 2.** During Phase 1 (2002–2010) 6 of the 11 stations were completed, as well as the access tunnel until the Vila Sônia yard, and the shells of additional four stations (figure 3).⁹ These four stations were expected to be completed during Phase 2 (2010–2018). In addition, it was expected that an additional station, its access tunnel, and a yard would be constructed during Phase 2. A Public-Private Partnership (PPP) model was conceived to partly finance Line 4, whereby the operation and maintenance (O&M) of the entire line was concessioned to a private operator. The concession was awarded for 30 years to ViaQuatro (CVQ) in 2006. It was the first PPP awarded in Brazil since the passage of the PPP legislation (2004). Line 4 Phase 1 was completed and fully operational between Butanta and Luz by May 2010. Because of the phased construction, the World Bank requested an agreement for the implementation of Phase 2 while Phase 1 would be in operation. The agreement was signed between the Sao Paulo Metro Company (hereafter *Metrô*, the implementing agency), the STMSM, and the private operating concessioner CVQ.

7. **Sao Paulo Metro Line 4 Phase 1 achieved its objectives.** The successful completion and achievement of outcomes of Phase 1 was evidenced by KPMG’s publication that included Line 4 among one of the 100 most innovative infrastructure projects in the world in July 2012. In parallel with the physical achievements, during this period the state also progressed in institutional aspects by creating the Integrated Transport Coordination Committee (CDTI), which was responsible for the introduction of an integrated tariff that remains until today (*Bilhete Unico Integrado*).

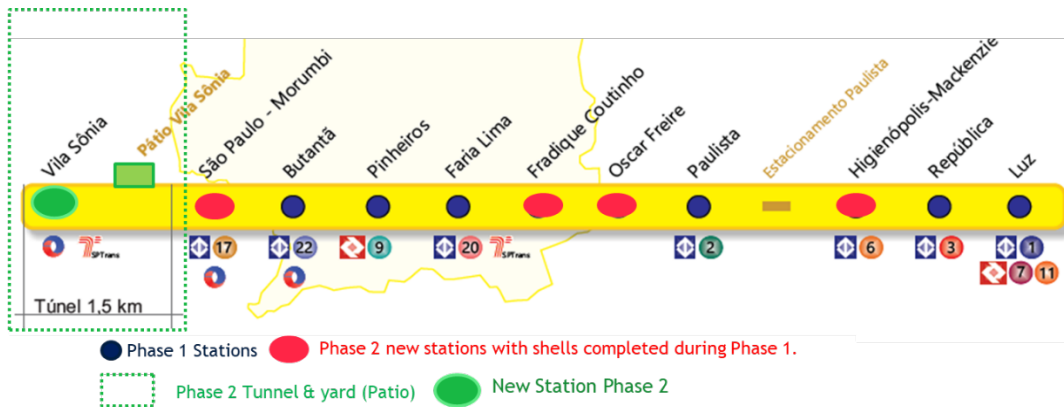
8. **The project was designed as a “Time-Series of Projects”.** While the project was not conceived as a Series of Projects, it was in practice designed as such, with the components of Phase 2 designed to complete the works started during Phase 1; both complete the entire Line 4.

⁸ See box 1.

⁹ The components of Phase 1 included the construction of, provision of equipment for, and O&M of, the metro line linking Vila Sônia yard facility to the Sao Paulo metro’s Luz station (Line 4) consisting of about 12.8 km of double underground track; 5 stations; and 4 station shells; acquisition and installation of system-wide facilities for the five stations (including fixed installations for electrification); and acquisition and operation of 15 train sets. At closing, the Phase 1 project included one additional station and 15 train sets.



Figure 3. Phase 1 and Phase 2 of Metro Line 4



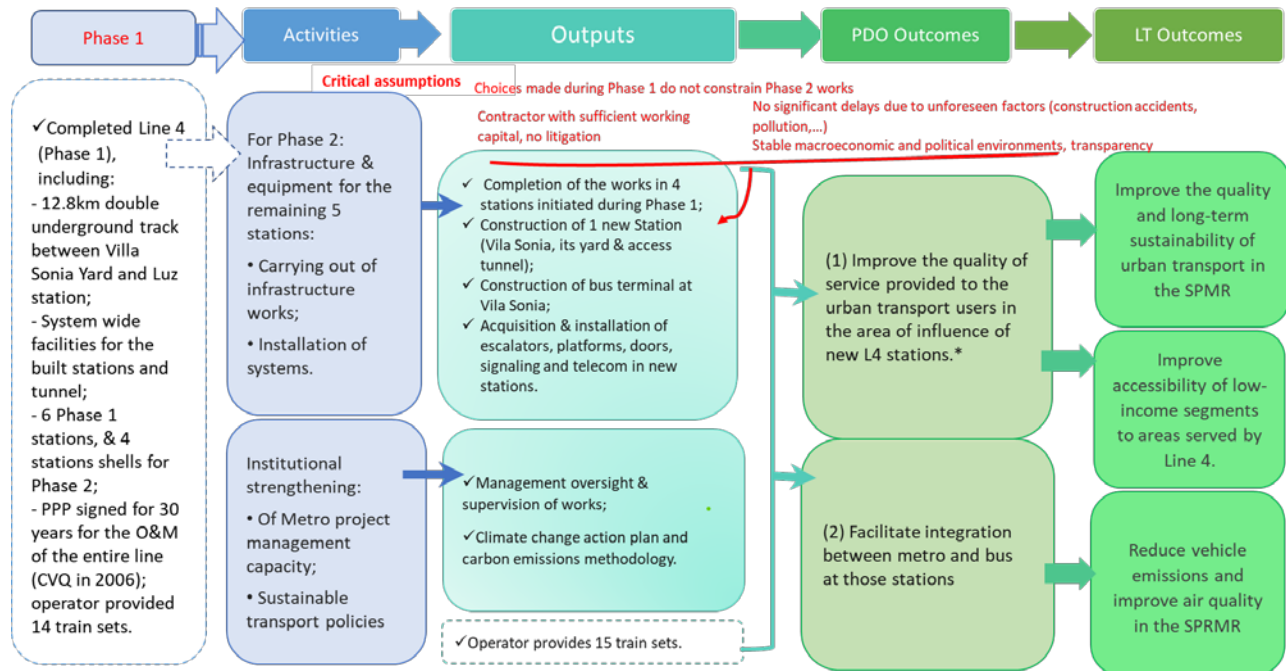
Note: Symbols below the metro line correspond to connecting lines from metro, CPTM, and EMTU. For simplicity they have not been detailed.

Higher-Level Objectives Context

9. **The project was in line with the World Bank Group Country Partnership Strategy (CPS) in Brazil.** At appraisal, the project was consistent with the CPS for Brazil in 2008–2011 (Report 42677-BR) which aimed at supporting equity, sustainability, competitiveness, and macroeconomic management. Primarily, the CPS recommended supporting policies and investments that would encourage economic growth and social development in a context of macroeconomic stability, with an emphasis on efficient resource allocation, efficiency in the public sector, and the appropriate targeting and delivery of support systems to the poor. The project was also in line with the strategy of the World Bank’s transport sector identified as follows: (a) the promotion of financial viability of public enterprises and their reform, including decentralization to various levels; (b) contribution to poverty alleviation; and (c) the reduction of Government subsidies through better tariff policies.



Theory of Change (Results Chain)



Project Development Objectives (PDOs)

10. **PDOs in the Loan Agreement.** The PDOs stated in the Loan Agreement of the project has the following two objectives which represented the expected outcomes of the project.

- (a) **PDO 1:** To improve the quality of service provided to the urban transport users in the area of influence of the new Line 4 stations (São Paulo-Morumbi, Fradique Coutinho, Oscar Freire, Higienopolis-Mackenzie, and Vila Sônia);
- (b) **PDO 2:** To facilitate the integration between metro and bus at those stations.

Key Expected Outcomes and Outcome Indicators

11. Table 1 presents the indicators used to measure each of the outcomes.

Table 1. Outcome Indicators

PDO	Indicators
PDO 1: Improve the quality of service provided to the urban transport users in the area of influence of the new Line 4 stations (São Paulo-Morumbi, Fradique Coutinho, Oscar Freire, Higienopolis-Mackenzie, and Vila Sônia);	Travel time plus average waiting time between pairs of stations (in minutes at peak hour), specifically between Vila Sônia-Luz; Fradique Coutinho-Luz; Higienopolis-Mackenzie-Luz.



PDO	Indicators
<p>PDO 2: Facilitate the integration between metro and bus at those stations.</p>	<p>Percentage of 5 new stations integrated with bus lines.</p> <p>Total annual passenger boarding in new stations (both directions, millions); at Sao Paulo-Morumbi, Fradique Coutinho, Oscar Freire, Higienopolis-Mackenzie, and Vila Sônia.</p>

Components

12. Component A: Infrastructure and Equipment Investment (estimated cost US\$471.438 million).

Civil works include (a) construction to extend the running way in tunnel segments from the Vila Sônia yard; (b) construction of a 500 m single-track tunnel to access Vila Sônia yard in parallel to the double-track tunnel; (c) construction of an underground station at Vila Sônia and connecting tunnels and the construction of a two-level bus terminal at Vila Sônia station; (d) completion of the Fradique Coutinho station, including finishing works for the Pinheiros access tunnel; (e) completion of Oscar Freire, Higienopolis-Mackenzie, and Sao Paulo-Morumbi stations; (f) construction of a two-level maintenance facility on Rua Pinheiros and the completion of the Vila Sônia yard; and (g) acquisition and installation of escalators, platform doors, and signaling and telecommunications systems necessary to operate the stations referred to earlier.

13. Component B: Technical Assistance (estimated cost of US\$32.664 million). Technical assistance for (a) management oversight and supervision of carrying out of Component A of the project and (b) carrying out of specific studies or assessments required during the execution of the project, including among other things a study for estimation of carbon emissions reduction due to the implementation of Line 4.

14. In addition, the trains and signaling systems were to be provided by the private sector concessionaire (CVQ). The operating company supplied 14 trains for Phase 1, with an option for 14 more trains for Phase 2. The additional 15 trains and systems were to be compatible with those provided in Phase 1.

15. The estimated costs for the components at appraisal and at closing of the project (Phase 2) are presented in table 2.¹⁰ Table 2 also includes the financing sources for the entire project as of closing date, including the costs financed and estimated to be financed under Line 5 Project. Annex 3 Table 3.2 includes the percent completed by component under the Line 4 and Line 5 Projects. At closing of Line 4 Phase 2, 62 and 67 percent of Components A and B were completed, respectively.

Table 2: Total Actual and Estimated Costs for Project Completion (US\$, millions)

Project Components	Final Project Costs ^e	Estimated at Appraisal ^d	% Variation
Component A - Infrastructure and Equipment Investment	526.181	471.438	11.61

¹⁰ The detailed appraisal cost table is presented in annex 3.



Project Components	Final Project Costs ^e	Estimated at Appraisal ^d	% Variation
A.1 Civil Works	388.689	331.899	17.11
A.2 Systems	70.719	-	
A.3. Water Treatments	1.134	-	
A.4 Rails	13.799	-	
A.5 Supplementary systems	2.847	-	
A.6 Expropriations	31.738	-	
A.7 Complementary Systems (SCAP, PSD, and STD)	17.255	-	
Component B. Technical Assistance^a	33.476	32.664	2.49
B.1 Project Management Oversight Consultant (PMOC)	10.902	-	
B.2 Automatic Trains Operations [ATO] - Technical Support of Works	2.386	-	
B.3 Works Supervision	2.996	-	
B.4 Systems Supervision	4.962	-	
B.5 DDs	1.628	-	
B.6 Advanced expenditures (technical studies)	10.602	-	
Unclassified	69.074	-	
Technical studies, traffic management, licenses, and so on	69.074	-	
Font end fee (IBRD)	0.325	-	
Price and Physical Contingencies		96.73	
Total Project Cost ^b	629.056	600.85	4.69
Financing Sources			
Total financed by IBRD (BR-7869) Line 4 Phase 2	130	130	161
Total financed by IBRD (BR-7855) Line 5 ^c	210	-	
Total financed by Japan Bank for International Cooperation (JBIC)	129.99	129.99	0
Total counterpart	159.07	340.91	-47

Note: DD = Detailed design.

a. The technical assistance component might be higher when considering some of the unclassified expenses; b. Project costs at appraisal excluding price and physical contingencies were estimated at US\$504.12 million; c. The completion of the project was transferred to be financed under the World Bank Line 5 Project (P116170), see next sections; d. For detailed costs at appraisal see Annex 3; they have not been included here because categories do not match; e. Including actual costs financed under Line 4 Phase 2 and the Line 5 project, as well as estimated costs under the Line 5 project.

B. SIGNIFICANT CHANGES DURING IMPLEMENTATION

16. The project went through two formal restructurings. The loan closed on February 28, 2018 and was fully disbursed.

Revised PDOs and Outcome Targets

17. The PDO was not revised.



18. **Outcome targets were adjusted.** Targets of two outcome indicators were reduced in the April 2016 restructuring of Line 4 Phase 2 with the expectation that they would be met in 2020; one was also modified based on updated data (neither change involved reducing the scope of activities) (see table 3):¹¹

- Based on the 2016 restructuring of Phase 2, the outcome targets for travel times between pairs of stations were modified. Between Fradique Coutinho-Luz and Higienopolis-Mackenzie-Luz they were expected to decrease just 1 minute less than originally expected by the extended closing of February 2018 due to calculation updates. The targeted travel time between Vila Sônia-Luz was not expected to be reached by the closing date of Line 4 Phase 2 but later (under the World Bank Line 5 financing [P116170], see paragraph 20). The final target was also revised by adding 2 minutes due to calculation updates. Overall, the restructuring updated the targets for 2018 and 2020.
- All Phase 2 stations were likewise not expected to complete 100 percent integration with buses by the closing date of Line 4 Phase 2, but by 2020. In 2018, 91 percent was expected to be completed.
- Volume of annual passenger boardings was corrected to adjust targets with new available information (see paragraph 24). The sub-indicator measuring volume of annual passenger boardings at Vila Sônia was technically dropped from Line 4 Phase 2 but substantively maintained by including it to the Line 5 project in the June 2016 restructuring of the latter with the target established based on the new available information.¹²

Table 3. Changes in Outcome Targets

PDO Indicator	Line 4 Phase 2 (P106390)			
	Baseline at Appraisal	Original Targets (2010)	Revised Targets (RP 2016) for Closing 2018	Revised Targets (RP 2016) for 2020 ^a
PDO 1:				
(i) Travel time plus average waiting time between pairs of stations (in minutes at peak hour):	55.00	20.00	40.00	22.00
- Vila Sônia-Luz	55	20.00	40.00	22.00
- Fradique Coutinho-Luz	26	10.00	11.00	11.00
- Higienopolis-Mackenzie-Luz	13	5.00	6.00	6.00
PDO 2:				
(ii) Percentage of 5 new stations integrated with bus lines	0	100	91	100
(iii) Total annual passenger boardings in new stations (both directions, million) ^b	—	—	—	—
- Vila Sônia	0	47.00	Removed	26.5

¹¹ Because the original targets—that is, the targets set out for when the entire line is completed—will be achieved in 2020, under the Line 5 financing, the scope of the activities was not modified. As a consequence, a split rating is not warranted.

¹² The Results Framework of the Line 5 project was restructured to include indicators pertaining to the finalization of Line 4 works.



PDO Indicator	Line 4 Phase 2 (P106390)			
	Baseline at Appraisal	Original Targets (2010)	Revised Targets (RP 2016) for Closing 2018	Revised Targets (RP 2016) for 2020 ^a
- São Paulo-Morumbi	0	17.10	8.5	9.3
- Fradique Coutinho	0	10.60	3.90	5.5
- Oscar Freire	0	10.80	7.20	7.4
- Higienópolis-Mackenzie	0	11.30	9.90	10.6

Note: RP = Restructuring Paper.

a. The original targets for PDO1 and PDO2 indicators are expected to be achieved by 2020 when all stations will be completed under the Line 5 project. The Line 5 project was extended to December 2018 in 2016 and to December 2020 in 2018; at Implementation Completion and Results Report (ICR) only Vila Sônia remains to be constructed. b. The end targets were revised because new data became available to update the transport model (see following section).

Revised Components

19. The components were not revised.

Other Changes

20. **Restructuring a complementary project for additional financing.** Initially, JBIC and the World Bank were expected to finance close to 22 percent of the total costs each, while counterpart funding was expected to be 57 percent of total project costs. In December 2015, the borrower requested to use savings of US\$210 million achieved under the Sao Paulo Metro Line 5 Project (P116170) to address the financing needs of Line 4 thus reducing direct counterpart funding in a tight fiscal situation for the SSP. As a result, in 2016, the World Bank agreed to restructuring the Line 5 project to include a part of the Line 4 Phase 2 that would not be completed at closing by February 2018; a corresponding authorizing law was passed in June 2016.¹³ The restructuring of the Sao Paulo Metro Line 5 Project was approved in June 29, 2017. Savings under Line 5 accrued from two sources: competitive International Competitive Bidding (ICB) procurement of the Line 5 train sets, one of the main components of the Line 5 metro project, and a reduction of taxes obtained by *Metrô*. The PDO and relevant intermediate indicators related to the completion of these works were also transferred to the Results Framework of the Line 5 project at closing of the Metro Line 4 project.¹⁴ For the second restructuring of Metro Line 4, the Results Framework was updated to account for both timelines, that is, expected at closing in 2018 and in 2020 when the final station will be completed under the Line 5 project.

21. **Cumulative extensions totaled 44 months.** The project was first extended in the 2014 restructuring by 22 months from June 2014 to April 2016 and then in the 2016 restructuring by 22 months to February 2018. Given the new schedule for completion of Vila Sônia station and access tunnel, the Sao

¹³ The authorizing law n.16,247 was approved on June 7th, 2016, as documented in the ISR of P116170.

¹⁴ The Results Framework under Line 5 included the PDO and intermediate indicators related to the completion of Vila Sonia stations, its tunnel, yard and bus terminal, with outcome targets set to its original closing date of 2018. In October 2018, Line 5 was extended by 24 months to allow for the completion of the remaining civil works of Line 4. The Results Framework will be consequently updated in a future restructuring to reflect outcome targets for 2020 as specified in the EA of the Line 4 RP 2016. The PDO of the Sao Paulo Metro Line 5 Project now is defined as (a) to improve the mobility of public transport users in the Capao Redondo-Largo Treze-Chacara Klabin (Line 5) and Vila Sônia-Luz (Line 4) corridors in a cost-efficient and environment-friendly manner and (b) to facilitate the integration between metro and bus at the metro stations.



Paulo Metro Line 5 Project was extended by 24 months until December 2020, with the restructuring approved on October 30, 2018.

22. **Actual component costs slightly increased compared to appraisal estimates.** Overall, estimated costs for Component A increased by 11.61 percent of the total cost estimated at appraisal, with civil works increasing the most by 17.11 percent. Overall, total project cost is estimated to be 24.9 percent higher than at appraisal but only 4.84 percent higher when accounting for the included physical and price contingencies. While costs increased marginally, sources of funding did change significantly as mentioned earlier. The World Bank's final financing contribution is estimated to be 161 percent higher than at appraisal.

Rationale for Changes and Their Implication on the Original Theory of Change

23. **First, the restructurings aimed at addressing delays due to contractual impasses and incomplete DDs that ultimately led to the rebidding of the two main civil works contracts.**¹⁵ These delays necessitated the first closing date extension by 22 months (2014 restructuring). Phase 2 of Line 4 faced delays during the initial procurement of the two main civil works contracts. The basic engineering designs for the civil works were completed in 2011 and two procurement processes for these civil works were issued using ICB in 2012. Implementation of these two large civil works contracts was however delayed due to (a) legal injunctions by firms that were not pre-qualified which halted the procurement process (all were ultimately considered unjustified), (b) additional time required by the winning international bidder to register as a company in Brazil, (c) design modifications because of unforeseen scope changes and the consequent delay to approve the final DDs, (d) unexpected construction site conditions including contaminated soils and water intrusion, and (e) delays in receiving authorization for traffic management around construction sites. The second extension resulted from the slowdown of construction and its interruption by December 2014. The delays in approving DDs and the limited capital of the construction company significantly stalled construction. A contractual impasse with the contractor led to the cancellation of these two main civil works contracts in September 2015 and their rebidding in November 2015. The new contract was awarded in May 2016 and signed in July 2016. These delays warranted the second closing day extension by 22 months (2016 restructuring). See timeline in annex 6.

24. **Outcome targets were also revised during the second restructuring to reflect delays in implementation, and the economic analysis (EA) was updated with new information unavailable at appraisal.** First, the revision of outcome targets was prompted by the delays; in 2016 it became evident that Vila Sônia station would not be completed by the 2018 closing date. Second, the new OD Survey (2007)¹⁶—a household travel survey that is the basis for the city's transport demand models—became available, providing updated information about the travel behavior of the population of the SPMR. At appraisal, only the 1997 survey has been available which compromised the demand estimations for the new stations.¹⁷ This updated data, as well as the progress on the integration with buses and the opening of new stations in Line 5, impelled a need to revise the demand targets and update the EA. These two

¹⁵ The civil works contracts were divided in 2 lots: Lots 1 and 2 (L04-1 and L04-2). They include finishing the yard at Vila Sônia station and the four shell stations built during Phase 1 and the extension of Vila Sônia station and its complementary facilities. All resettlement/expropriations were completed by end 2011. The procurement of systems in Lot 3 (L04-3) was initiated by end 2012.

¹⁶ OD surveys are carried out every 10 years and there are usually substantial delays in their completion.

¹⁷ The PAD, at appraisal, noted the importance of revising the numbers.



reasons led to changes in outcome targets. These were updated with new information and were modified to reflect the different timelines, that of closing of Phase 2 in 2018 and that of completion of the civil works expected for 2020. Intermediate indicators were revised accordingly. As such, the scope of the project was not modified, and targets will be achieved under the Line 5 project after the completion of works in Vila Sonia (see table 3).¹⁸

25. **The transfer of the final works of Metro Line 4 to the Metro Line 5 project aimed at leveraging financial resources and ensuring the sustainability of the original project.** The difficult macroeconomic and fiscal situation of Brazil in 2015 and 2016 made it unlikely that more financial resources would be available for an additional financing under the Line 4 Phase 2 project to offset the financing gap to conclude civil works of Line 4. Given that Metro Line 5 achieved significant savings during the ICB procurement of the trains, resulting in approximately US\$210 million of uncommitted balance, *Metrô* and the World Bank agreed that the best solution to ensure the sustainability of the project and leverage available financial resources was to extend the Line 5 project and restructure it to incorporate the unfinished civil works of Line 4. This innovative restructuring would not only allow for the successful completion of Line 4 but also ensure the sustainability of the project management team.

26. **The original Results Chain (Theory of Change) remained valid from appraisal of the original project until closing.** The PDO and associated components were not changed during the life of Line 4 due to their continued relevance.

II. OUTCOME

A. RELEVANCE OF PDOs

Assessment of Relevance of PDOs and Rating

27. **The PDOs remained highly relevant to the World Bank's Country Partnership Framework (CPF) at closing.** PDO 1 and PDO 2 aimed at improving the quality of service provided to urban transport users in the area of influence of the new Line 4 stations and facilitating the integration between metro and bus at those stations. These PDOs fully align with the CPF for Brazil for the period FY18–FY23 (Report No. 113259-BR, dated May 16, 2017), namely with the focal areas of 'Inclusive and Sustainable Development' and its objective to provide more 'Inclusive and Sustainable Urban Services' and of 'Private Sector Investment and Productivity Growth' and its objective to mobilize greater investment in infrastructure to improve services. The CPF at closing puts emphasis on the need to improve efficiency in public service delivery to enhance the quality of life of citizens. The PDOs of the project directly address these imperatives. As the SPMR has continued to face high demand for adequate public transport,¹⁹ improving the quality of the service and the integration with buses remain central to the urban mobility and quality of life of its residents. There are about 44 million day-trips in the SPMR, with an average trip duration of

¹⁸ Because the revised targets do not modify the scope or ambition of the project, split ratings are not used in this ICR. The original outcome targets will be achieved at the closing of the Line 5 Project (P116170), when works in Vila Sônia station are completed. The slight modification of the targets only reflects shortcomings in the original targeting, given that there was inadequate information (OD 1997) to model demand at stations accurately.

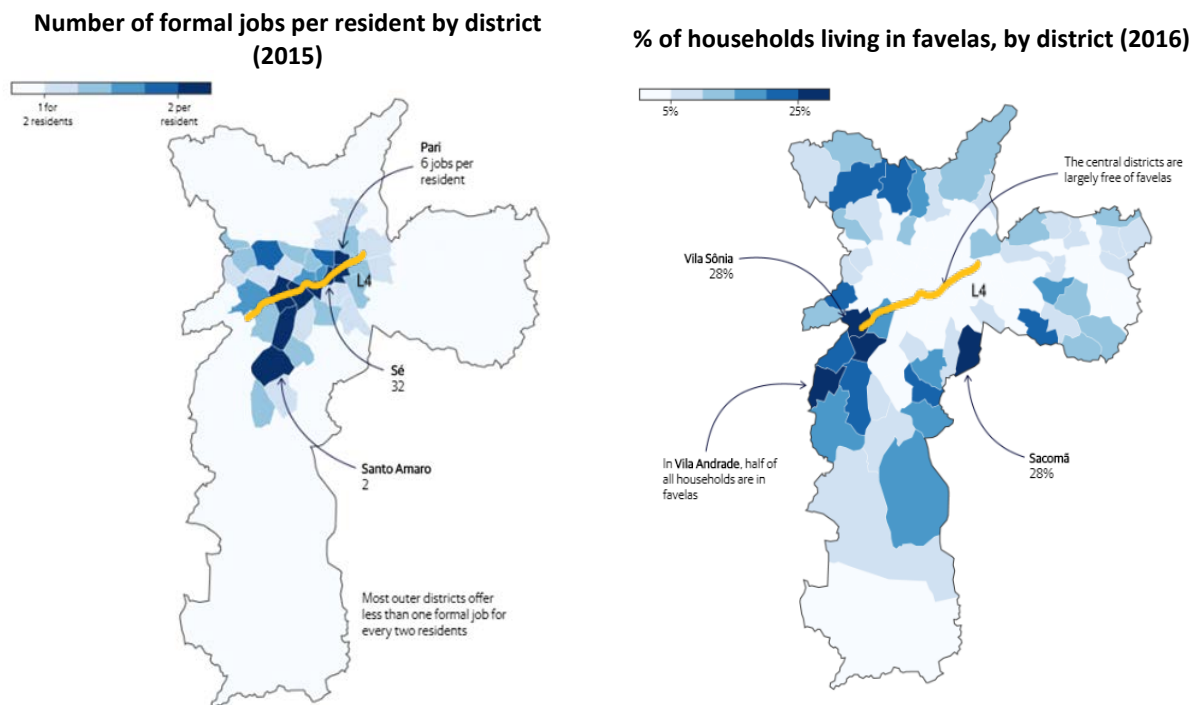
¹⁹ See this article for anecdotal evidence: <https://www.theguardian.com/cities/2017/nov/29/four-hour-commute-grind-life-sao-paulo-periphery>.



67 minutes for public transit users (OD Survey 2007, 2012). According to Moovit, 30 percent of residents have commuting times longer than 2 hours every day²⁰ and 18 percent travel for over 12 km in a single direction. Congestion is among the highest in Latin America: in 2013, it was estimated that it costed the city close to 8 percent of the metropolitan area GDP.²¹ The metro system of Sao Paulo is 93.6 km in length,²² and despite being one of the most productive in the world in terms of passengers per kilometer and passenger per car-kilometer, its share is still low due to limited extension. The area of influence of Line 4 encompasses some of the busiest central areas (Paulista-Luz segment) of the city as well as some of the poorest residential ones close to Vila Sônia station. Accessibility to and from these stations and the connection Line 4 allows with other central lines (directly it connects with *Metrô* and CPTM Lines 1, 2, 3, 7, 9, 11, and 22 and allows interconnection with EMTU buses) are essential to ensure the sustainability of the urban transport network and provide access to economic opportunities and urban amenities for all residents (figure 4). Further, the integration of the public transport modes such as metro with buses remains a key question to achieve the sustainability of the system. According to Moovit, 25 percent of residents are estimated to transfer at least twice when travelling to a certain destination on a single journey.

28. As a consequence, the relevance of the PDOs is **High**.

Figure 4. Economic opportunities, Informality and Area of Influence of Sao Paulo Metro Line 4



Source: Maps adapted from The Guardian/Rede Nossa Sao Paulo.

²⁰ https://moovitapp.com/insights/en-gb/Moovit_Insights_Public_Transport_Index_Brazil_Sao_Paulo-242

²¹ Os custos da (i)mobilidade nas regiões metropolitanas do Rio de Janeiro e São Paulo, FIRJAN (2013).

²² Metrô CPTM, ed. (29 de setembro de 2018). *Agora ligada aos ramais 1-Azul e 2-Verde, Linha 5-Lilás vai atrair meio milhão de pessoas por dia*. Last visited September 29, 2018.



B. ACHIEVEMENT OF PDOs (EFFICACY)

Assessment of Achievement of Each Objective/Outcome

PDO 1: Improve the quality of service provided to the urban transport users in the area of influence of the new Line 4 stations (São Paulo-Morumbi, Fradique Coutinho, Oscar Freire, Higienopolis-Mackenzie, and Vila Sônia)

29. **The project has and is expected to substantially improve the quality of service provided to urban transport users in the area of influence of the new Line 4 stations.** All four stations expected to be completed from the shells of Phase 1 (Fradique Coutinho, Higienopolis-Mackenzie, Oscar Freire, and Sao Paulo-Morumbi) were operational by end-October 2018. The first two became operational within the Line 4 Phase 2 closing date and the other two within 8 months; 78 percent of these four stations was completed by February 2018²³ and 94.6 percent as of October 2018²⁴; with 68.13 percent of systems installation concluded by October 2018, as well. Only one station, Vila Sônia, will be completed in 2020 under Line 5 financing. These achievements have allowed and are expected to significantly improve the quality of service for public transport users in the area of influence of the new Line 4 stations. Travel time plus average waiting times at peak hour on the overall operational line is 32 minutes against the revised target of 40 minutes for 2018 closing date and is expected to drop further to 22 minutes against the original target of 20 minutes once Vila Sônia station is completed.²⁵ This significant achievement will lead to 60 percent travel time savings for public transport users in the area of influence of Metro Line 4 and particularly for residents near Vila Sônia station, which are among the poorest residents in the SPMR (figure 5).²⁶ The segments Fradique Coutinho-Luz and Higienopolis-Mackenzie-Luz also reached their intended target of 11 minutes and 6 minutes, respectively, achieving considerable time savings for users. The likelihood of completion of Vila Sônia station is high, given the secured financing from Line 5 project and satisfactory IP rating (as of August 2018, close to 30 percent of works were completed at the station).

30. **Reduced travel times contribute to increased demand at new operating stations.** All operating stations have met or are expected to meet their total annual boarding targets. Total annual boardings in the operational station of Fradique Coutinho was 3.8 million (October 2018) against the targeted 3.9 million, practically meeting its target at closing. Newly opened stations in 2018—Higienopolis-Mackenzie and Oscar Freire—aimed at achieving total annual boardings of 9.9 million and 7.2 million, respectively, by December 2018. After 8 months and 4 months of operations, respectively, they show signs that these targets will largely be achieved. Since opening, Higienopolis-Mackenzie had a total of 32,710 average daily passengers boardings, leading to an annualized value of 10 million passengers; while Oscar Freire had a total of 23,660 daily passenger boardings, for an annualized value of 7.2 million. After only a week of operations, the Sao Paulo-Morumbi station is showing 27,000 daily passenger boardings, indicating that

²³ By closing date, civil works at stations Fradique Coutinho and Higienopolis-Mackenzie were 100 percent completed and Oscar Freire and Sao Paulo-Morumbi were at 86 percent and 45 percent, respectively. Overall 62 percent of the Infrastructure and Systems were completed by closing date; and 67 percent of the technical assistance component (see Annex 3).

²⁴ The indicator will reach 100 percent by December 2018 when the bus terminal at Sao Paulo-Morumbi station is also concluded, and one of the entries of Oscar Freire station (Clinicas Access).

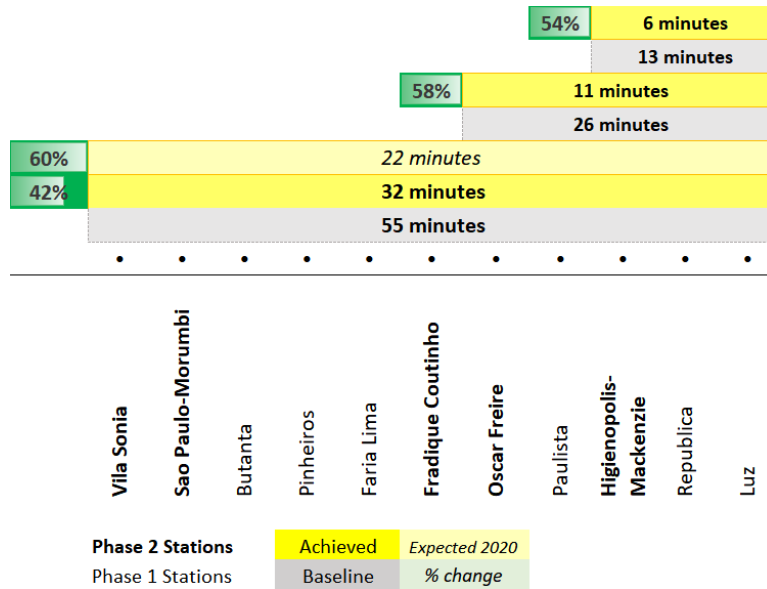
²⁵ The two-minute difference represents a calculation update.

²⁶ At baseline, the distance was estimated using a combination of buses and available metro lines for the same route (that is, the fastest available route by public transport). The endline indicator also includes a bus segment between Vila Sônia and Sao Paulo-Morumbi.



its annualized target of 8.5 million will be accomplished. These promising results support the achievement and expected achievement of PDO indicators by 2020 (see Table 3). Overall, with the new stations,²⁷ Line 4 has moved over 750,000 passengers per day on average in the past three months. The opening of Vila Sônia station in 2020 will increase demand and achieve a total of 893,520 passengers transported in Line 4 per day (excluding weekends).

Figure 5. Travel Time Savings Between Pairs of Stations at Peak Hour



Note: Travel times between pairs of stations in minutes, at peak hour as of October 2018. They include maximum waiting times. Data from Metrô. The baseline was calculated using bus times between the two pairs of location. Endline includes bus + metro in segment Vila Sônia-Luz (with bus until Sao Paulo-Morumbi).

31. **The new stations offer the latest technology and comfort, significantly improving service quality.** Line 4 is the first driverless heavy-capacity metro in South America. As such, the stations built during Phases 1 and 2 incorporate the latest technology for trains operations (Communications Based Train Control) including platform screen doors that only open when the train arrives to improve security, speed, and regularity in boarding times; information systems that inform passengers about train capacity and free spaces; and elevators to ensure universal accessibility (figure 6). The entire line allows cellular reception due to an agreement between CVQ and mobile telephone companies. Fradique Coutinho is also one of three stations in the line with a bike parking facility (86 spots) that operates between 4:40 a.m. to midnight (1 a.m.) during weekdays (Saturdays). These features significantly improve the quality of commuting as evidenced by commuters' satisfaction surveys, which have improved since the opening of the Phase 2 stations in 2018 (Oscar Freire and Higienopolis) going from 90.0 percent of satisfied users in October 2017 to 93.6 in April 2018.²⁸ According to this last survey, the two main qualities of Line 4 compared to other lines are the frequency and reliability of trips (43 percent) and the comfort of trains

²⁷ This excludes Sao Paulo-Morumbi station, where operation began on October 27, 2018; and data are insufficient.

²⁸ User satisfaction surveys are carried out biannually in October and April of each year. April 2018 is the most recent available survey at the time of writing the ICR.



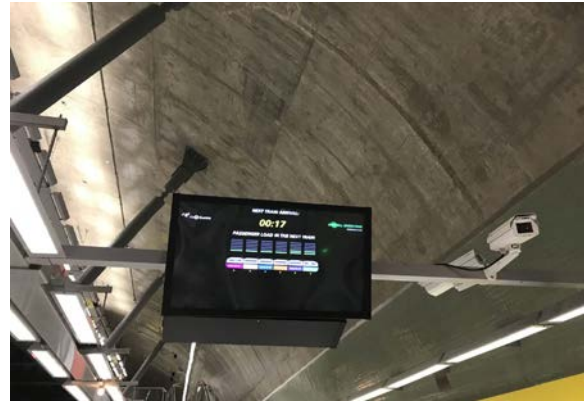
(28 percent). Metro Line 4 overall offered good quality of service on the operating line and at the new stations, with an average of 3.6 passengers per square meter in Line 4. There were no major accidents reported at newly opened stations to date.

Figure 6. Latest Technology at New Stations of Line 4 (Higienopolis-Mackenzie)

Platform doors in Higienopolis-Mackenzie station



Information system in Higienopolis-Mackenzie station

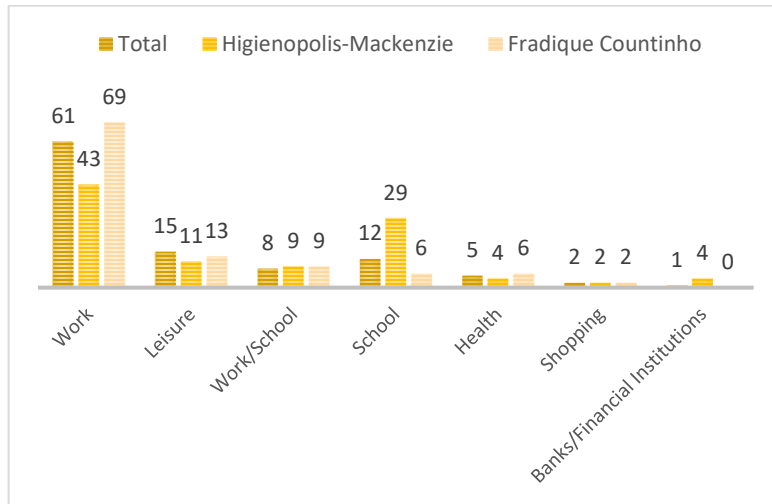


32. **Accessibility to jobs and urban amenities has also increased as a consequence for residents in the area of influence of the newly opened stations.** According to the latest user satisfaction surveys (April 2018) about 80 percent of users of Line 4 travelled for work and/or school reasons, with up to 86 percent and 71 percent of those boarding/alighting in Phase 2 stations Fradique Coutinho and Higienopolis-Mackenzie, respectively, using the line for this purpose (figure 7). According to the accessibility analysis carried out for Line 4 (figure 8), estimated mobility benefits are higher for low- and middle-income areas in the vicinity of Vila Sônia station than for the areas in richer neighborhoods around the stations of Oscar Freire and Higienopolis-Mackenzie stations. Given the network effects of the metro, other lower-income areas of the city in the east region have also benefited from the Line 4 expansion. These network effects were evidenced by an impact evaluation (IE) conducted by *Metrô*.²⁹ The data were collected before and after the implementation of Phase 1 for control and treatment areas. Network effects, whereby the population in the Eastern region was affected, compromised the evaluation design but allowed the gathering of evidence on the impact the line was having in this area. Still, the IE showed positive effects in terms of travel time savings and cost reductions for the users in the treatment area.

²⁹ Impactos da Linha 4 Relatório Final março 2015.

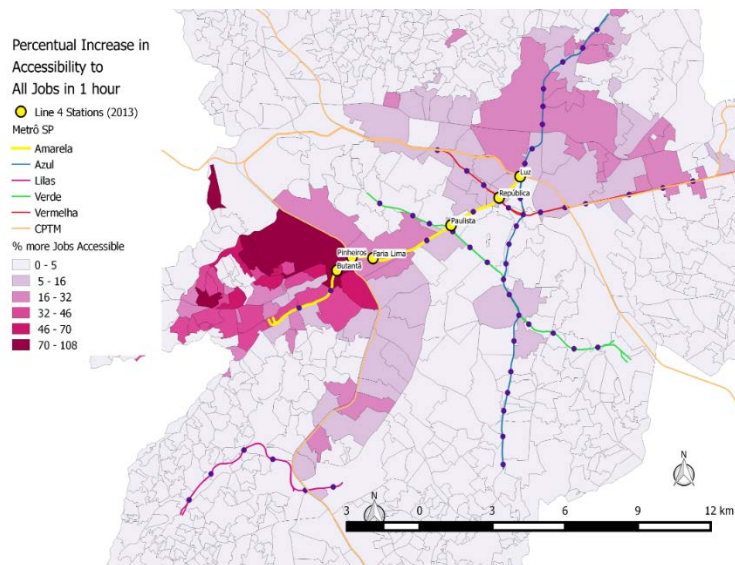


Figure 7. Overall Reasons for Using Line 4 (% of Users Surveyed)



Source: CVQ User Satisfaction Survey April 2018.

Figure 8. Increase in Accessibility to Jobs within 1-hour Commute Time (% Increase)



Source: OpenTripPlannerAnalyst [OTPA] tool analysis of Line 4 results.

PDO 2. Facilitate the integration between metro and bus at those stations

33. **Bus integration at operating stations was facilitated by the completion of the Phase 2 stations and is further expected to be improved with the completion of two bus terminals.** All operating stations are physically integrated with buses at the proximity or by direct connection to a bus terminal. At the time of the ICR, 91 percent of the new stations were facilitating physical integration with buses, reaching the end target for the PDO at closing of Phase 2. With the completion of Vila Sônia, the 100 percent original target will be achieved. Further, Vila Sônia and Sao Paulo-Morumbi stations will have direct connection with the bus terminals that are being built at the same location and will allow passengers to transfer with



both municipal and intermunicipal buses. The Vila Sônia station and bus terminal will be completed in June 2020 under the Line 5 project. To date, they are on track to be completed with 28.6 percent and 72 percent of the civil works in the station and terminal completed (October 2018), respectively. While the metro station in Sao Paulo-Morumbi was operational in October 2018, the bus terminal will be ready in December 2018 (97.6 percent total completion as of October 2018). Full integration is thus highly likely and complements the integration with other rail-based modes at the new stations: Higienopolis-Mackenzie will allow for the integration with the future Line 6 and Sao Paulo-Morumbi with the future Line 17. According to the latest user satisfaction survey of Line 4, the possibility of integrating with other lines and buses is considered as very good by 80 percent of users (increasing 3 percentage points since October 2017); 70 percent finding the transfer easy.

34. **Because of the successful integration, the demand at new operating stations has materialized as planned.** As mentioned, total annual boardings in the operational stations of Fradique Coutinho, Higienopolis-Mackenzie, and Oscar Freire achieved or were highly likely to achieve their annual boarding targets by December 2018. The integration has allowed for the efficiency benefits of transferring passengers from roads to rail-based modes. It was estimated that following the inauguration of Higienopolis-Mackenzie and Oscar Freire, the number of bus passengers in the adjacent bus corridors fell by 7.4 percent (August 2018, year-on-year). For the same period, the demand on Line 4 increased by 12 percent.³⁰ Overall 71.42 percent of passengers of Line 4 transferred from another line/mode. These promising results support the achievement and expected achievement of PDO indicators once the final station is completed.

35. **Bus integration is facilitated by the integrated tariff policy and physical integration of the stations.** In 2006, the *Bilhete Unico* was implemented in the SPMR, allowing the free transfer between metro, CPTM, municipal buses, and some intermunicipal buses by way of especially branded contactless farecards. The *Bilhete Unico* is the backbone of the multimodal integration of the public transport system. Further, Line 4 offers full physical integration with both rail and road-based modes at some of the Phase 2 stations. The operating stations of Phase 2, specifically Higienopolis-Mackenzie and Sao Paulo-Morumbi, have been built to be also physically integrated with the metro lines (future lines 6 and 17). Sao Paulo-Morumbi and Vila Sônia stations have bus terminals integrated at the stations. As these two stations are at the end of the line, the terminals will allow for an easier connection for bus users from municipalities outside of Sao Paulo Municipality. Finally, Fradique Coutinho allows for bicycle integration which improves the overall multimodal integration of the city.

Justification of Overall Efficacy Rating

36. **PDO 1 and PDO 2 were substantially achieved by November 2018 and are very likely to be fully achieved by 2020.** The project, despite delays, will fully achieve its objectives. At closing and by the time of writing the ICR, the Phase 2 project had significantly improved the quality of service for the urban transport users in the area of influence of new Line 4 stations, with travel time savings between Vila Sônia and Luz stations of up to 42 percent. The time gains are expected to reach 60 percent by 2020. The satisfaction with the quality of service of Line 4 and new stations is clearly evidenced by passengers' satisfaction surveys. Similarly, bus integration has been achieved and will continue to be improved with

³⁰ Information according to SPTTrans (<https://www.mobilize.org.br/noticias/11271/em-sp-novas-estacoes-do-metro-roubam-passageiros-de-onibus.html>); last accessed on October 27, 2018. The bus corridor is the *Campo-Limpo-Rebouças-Centro* corridor.



the opening of the bus terminals at Vila Sônia and Sao Paulo-Morumbi stations. Supported by the bold tariff integration (*Bilhete Unico*), the physical integration of the new stations will continue to benefit the sustainable mobility agenda by allowing the transfer of passengers to less polluting rail-based modes. Overall the project has significantly improved the accessibility of low-income users to the opportunities, amenities, and services and will continue to do so under the Line 5 project. All original targets have been achieved or are very likely to be achieved at closing of the Line 5 project.

37. Based on the evaluation above, the overall efficacy is rated **Substantial**.

C. EFFICIENCY

Assessment of Efficiency and Rating

38. **The project will benefit close to 1 million passengers travelling daily on Line 4.** The estimated demand for Line 4, once Vila Sônia becomes operational, is 893,520 passengers daily. Already between June and August 2018,³¹ there were on average 752,861 passengers travelling every day on the line.³²

39. **Cost overruns have not been significant considering the complexity of the project and the delays; but delays (80 months) impact efficiency.** Overall, direct project costs are 24.9 percent higher than appraised, which is generally common in large infrastructure projects. A price and quantity contingency were estimated at appraisal; when considering these contingencies, the Phase 2 project is only incurring a 4.84 percent cost overrun. The largest increase was on the civil works and equipment component. Civil works will have costed 17.11 percent more than appraised. Overall, the total cost of Phase 2—US\$629 million—is in line with benchmarks and much lower than similar complex infrastructure projects (see box 2).

40. **The EA ex ante was readjusted in 2016 to account for the updated demand expectations.** At appraisal, the EA for the original project included an analysis of the incremental investment in Phase 2 and for the comprehensive investment in Line 4 (Phases 1 and 2). The Economic Internal Rate of Return (EIRR) was estimated at 15.57 percent, for a Net Present Value (NPV) of US\$824.727 million at a discount rate of 10 percent for the entire line; and an EIRR of 7.57 percent was obtained for the incremental investments of Phase 2, with an NPV of US\$46.802 million at a discount rate of 7 percent. The project was restructured in 2016 to extend the closing date by 22 months. At the time, a new EA was carried out to incorporate the information to date, including the updated demand estimations and costs. The RP EA, which only considered the incremental impact of Phase 2³³ estimated an EIRR of 9.37 percent with a discount rate of 6 percent and obtained a total NPV of US\$439.1 million.

³¹ Last 3 months for which data are available. This includes only business days (252 total yearly in 2018).

³² Sao Paulo-Morumbi was not in operation yet by that time. Both Vila Sônia and Sao Paulo-Morumbi will significantly increase demand by extending the terminal for the first time since the opening of Line 4. Butanta has been the end station since then.

³³ Sunk costs, as well as the costs and benefits of Fradique Coutinho, which had been operational since 2014 were not included.



Box 2. The Long Construction of New York Metropolitan Transit Authority (MTA)’s Subway Lines Extension

In the past 20 years, the New York MTA completed two major line extensions: The Second Avenue/Broadway Express (Q train) and the Line 7 extension.

The Second Avenue (Q train) subway line runs under Second Avenue on the East side of Manhattan. The proposed full line would run 13.7 km and would have 16 stations. It is planned in three phases, of which only the first has been completed and started operation in January 2017. The first phase included three new stations in the Upper East Side and 3.2 km of tunnel for a total cost of US\$4.45 billion. Construction, which started in 1972 but was then halted until 2008 due to the city’s fiscal crisis, lasted almost 10 years. The second phase, between 125th and 96th Streets, is in the MTA’s 2015–2019 Capital Plan for planning, design, environmental studies, and utility relocation. A total of US\$535 million was allocated only for these activities and the designs include three new stations with the existing tunnel at 116th Street needing to be rebuilt to accommodate the new station.

The Line 7 subway extension is a subway extension of the New York City Subway’s IRT Flushing Line. The extension stretches 2.4 km southwest from its previous terminus at Times Square, at Seventh Avenue and 41st Street, to one new station at 34th Street and Eleventh Avenue. The project was originally proposed in 2005 as part of the Hudson Yards project, linked to New York City’s bid for the 2012 Summer Olympics, and originally included two stations. Construction started in 2007 and costed an estimated US\$2.4 billion. The project was severely delayed due to cost overruns, the difficulty of constructing where other stations existed (such as platforms in 42nd street for the Port Authority Bus Terminals), and contracting disagreements. The project was originally expected to be completed for 2012 but took 8 years and was finally delivered by end 2015.

41. **The ICR EA is focused on the incremental gains of Phase 2.** Given that the project is still ongoing, the ICR EA (annex 4) follows the methodologies used in the RP 2016 (Report No: RES18682). The difference is that it includes all Phase 2 stations in terms of benefits and costs. There were minimal modifications on passengers per kilometer-passengers per hour given that demand at operating stations has materialized as planned and demand assumptions at Vila Sônia and Sao Paulo-Morumbi stations have not changed. The NPV of the ICR EA yields US\$140.6 million at the discount rate of 6 percent, which is lower than that at project restructuring (2016), but higher than that at appraisal of US\$46.802, where all costs were also included. Still, the ICR EIRR is 8.65 percent, higher than that at appraisal (7.57 percent). Thus, the overall project remains economically viable and is set to realize the estimated economic benefit revised in 2016. The details of the ICR EA are presented in annex 4.

Table 6. Summary of EA

	EA in the PAD	Revised EA RP 2016	ICR EA
Total project cost appraised (US\$, millions)	504.102	415.974	597.6
Total stations appraised (#)	5	4	5
Total tunnel appraised (km)		1.5	
Total bus terminals (#)		2	
Total yard (#)		1	
Percentage of IBRD financed cost as of total cost	21.59	31.3	54.04
NPV (US\$, millions)	49.5	439.1	140.6
EIRR (%)	7.57	9.37	8.65
Discount Rate (%)	7	6	6
Benefit-to-cost ratio	1.04	1.34	1.22



Note : Revised EA 2016 excludes Fradique Coutinho ; Ex post EA includes Fradique Coutinho. All costs exclude taxes; cost at RP 2016 excludes sunk costs. With a 7 percent discount rate, the ICR NPV would be lower at US\$73.166 million.

42. **While the EA still shows a good EIRR and positive NPV, other factors affected efficiency negatively.** First, penalties had to be negotiated with the operating concessionaire due to the significant delays in finalizing stations. These penalties are still being negotiated and their cost is not considered here. Second, the difficult negotiations with all parties involved and the overall 70 months delays—including the cancellation of the initial awarded contract—also imply high opportunity costs that are very difficult to quantify. Finally, public opinion and trust on the public transport system has also been affected by the delays, with negative press coverage of the missed deadlines. These factors negatively impact efficiency.

43. Based on the results of the EA which indicated the expected economic indicators of the project activities, but considering cost overruns and delays, the efficiency of the project is rated Modest.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

44. The project objectives are highly relevant to the metropolitan area and country's priorities, and they are aligned with the World Bank's current CPF. Overall, the project achieved its objectives set for the 2018 closing and are expected to achieve the original targets once the Metro Line 5 project closes in 2020, resulting in important welfare gains for the targeted population. Further, an ex post EA demonstrated its economic viability. Delays and cost overruns common to very complex infrastructure projects have negatively affected the overall efficiency but have not jeopardized the economic and social benefits of a very complex project. Thus, the ICR assesses overall outcome as Moderately Satisfactory.

E. OTHER OUTCOMES AND IMPACTS

Gender

45. **While the project did not have any specific gender action; the infrastructure constructed at stations and improved accessibility supports women's mobility in the SPMR.** Generally, women face more mobility constraints than men due to their primary caregiver roles, lower affordability, and security concerns. They are also more dependent on the public transport system than men. For instance, inadequate public transportation may limit women's ability to choose whether to work and how to work outside of the home as well as move freely for other purposes including accessing public services (World Bank Mobility Report 2017).³⁴ According to a study on women's mobility in the SPMR conducted by the municipality in 2016,³⁵ 74.6 percent of women use public transport or walk as their main mode of commute compared to 62.5 percent of men. The investments of the project supported women's mobility by the following ways:

- (a) Increasing overall accessibility to economic opportunities and urban amenities in the area of influence of the newly built stations—in particular when Vila Sônia station enters into full

³⁴ World Bank. 2017. *Global mobility report 2017: tracking sector performance (English)*. Global mobility report series. Washington, D.C.: World Bank Group.

³⁵ http://smul.prefeitura.sp.gov.br/informes_urbanos/pdf/39.pdf



operation in 2020, women in one of the poorest areas of the city will improve their daily commuting times to the city center.

- (b) Building stations that are properly lit and include the latest technology such as information on the capacity of the train (full, half full, and so on), increasing security for women who can choose emptier trains where harassment is likely to be lower. User satisfaction surveys indicate that 80 percent of users found sexual harassment actions in Metro Line 4 were good or very good (April 2018).³⁶
- (c) Providing physical integration between bus stops and metro stops to shorten the time of transfer between the two and reducing the exposure to unsafe routes. A recent study by ActionAid that included four Brazilian cities showed that 75 percent of female respondents have changed their route because they were afraid in a street without proper lighting and 70 percent have opted not to go out in the street in the evening because they were afraid of being harassed.³⁷

46. **While women were employed in the construction site, the proportion was low indicating there are still obstacles for the employment of women in the sector.** Data on the employed workforce in the construction sites of stations indicate that the contractors employed approximately 3.8 percent of women in the construction site of the Phase 2 stations from January to September 2018. The percentage is small. It is in line with the low participation of women in the sector. In 2012, according to a Labor Force Survey (IBGE) only 8.5 percent of women were employed in the construction sector in Brazil, 8.4 percent in the construction of underground transport infrastructure.³⁸

Institutional Strengthening

47. **The use of a Dispute Board present in FIDIC³⁹ contracts has allowed for a rapid resolution of conflicts and the strengthening of Metrô's knowledge of this type of contracts.** Brazilian procurement processes and regulations set by the 8666 Law does not include the use of Dispute Boards. By using the World Bank procurement framework, the civil works contracts are FIDIC contracts that allowed and encouraged the use of this mechanism. As a consequence, *Metrô* was able to use the Dispute Board when handling conflicts which has, particularly during the second civil works contract,⁴⁰ been very effective and resolved most of the differences. The Board was used twice since 2017.

48. **While there is no regulatory agency in the SPMR, *Camaras Tematicas de Transportes (Regional Thematic Council, RTCC)* have been put in place and supported through the project.** As part of the CDTI—an informal regulatory committee to discuss public transport integration among the different state and municipal actors of the SPMR—the RTCC has been put in place to create a regional coordination entity for planning, coordinating, and setting priorities for new investments and modal integration. While these were defined during Phase 1, and while primarily being a forum for discussion, the RTCC remains one of

³⁶ An active awareness campaign has been carried out in 2018 which drastically increased the percentage by 11 percentage points from October 2017.

³⁷ <https://www.itdp.org/2018/04/18/st-mag-why-gender-matters/>

³⁸ <https://revistas.unifacs.br/index.php/rde/article/viewFile/4161/2914>

³⁹ The International Federation of Consulting Engineers is commonly known as FIDIC.

⁴⁰ After the cancellation.



the only points of interaction between the two main bodies responsible for the SPMR urban transport coordination. Phase 2 has supported the RTCC during its supervision missions by emphasizing the importance of a regulatory agency and showing interest in their work.

Mobilizing Private Sector Financing

49. **Similar to Phase 1, Phase 2 relied on the private concessionaire CVQ for the acquisition of new trains and the O&M of the stations constructed.** The O&M of Line 4 was concessioned to CVQ in 2006 for a period of 30 years. The 30-year concession contract includes the operation of Metro Line 4 as well as investment and installation of rolling stock, signs, track connections, and data transmission in the train networks. This PPP agreement that was signed during Phase 1 (2006) continued to work successfully during Phase 2, providing a great example of the benefits of using the Maximizing Finance for Development framework in the context of large transport infrastructure investments. CVQ supplied 14 trains in Phase 1 and 15 additional trains during Phase 2, for a total of 29 trains. An estimated US\$450 million of private investment was made in Line 4 between 2010 and 2018 by the concessionaire CVQ for O&M. In 2018, as part of the consortium ViaMobilidade, CVQ was awarded the O&M of Line 5, signaling the good results of Line 4.

Poverty Reduction and Shared Prosperity

50. **Line 4 has and will significantly improve the mobility and accessibility of the bottom 40 percent in the SPMR.** Overall, the civil works and systems financed under Line 4 Phase 2 have allowed significant time savings between the pairs of station of Line 4. Consequently, they have improved accessibility for the low-income households living in the area of influence of the stations (see Figure 4). Particularly, the future Vila Sônia station will significantly improve accessibility for low-income residents in the west part of the city which host some of the poorest households in the metropolitan area. For instance, about 28 percent of residents in Vila Sônia are estimated to live in favelas (2016). The accessibility analysis shows a significant improvement for residents in this part of the city (figure 8), where the average formal wage was estimated to be as much as five times lower than in the richest districts of Sao Paulo in 2017.⁴¹ Additionally, Line 4 has significantly increased mobility and accessibility for the low-income residents in the eastern and northern peripheries of the SPMR. Physical and operational integration, which has been accentuated with the newly opened stations of Phase 2, with other metro lines, CPTM, and bus lines has been at the core of these achievements.

Environmental Impacts

51. **The operating segment of Line 4 has already contributed to the reduction of greenhouse gas (GHG) emissions and air pollutants.** *Metrô* estimates that the operating segment of Line 4 contributes as of June 2018 to an estimated reduction of 47,200 tons of GHG emissions and 659 tons of air pollutants per year. The overall savings in fuel consumption have been of 23.2 million liters per year. Phase 2 financed a study for estimation of carbon emissions reduction due to the implementation of Line 4 and the methodology developed under the study is used to measure the above results.

⁴¹ Map and data developed by Rede Nossa Sao Paulo (2017). The district with the highest average formal wage was Campo Belo (BRL 10,079). In Vila Sônia it was BRL 2,155.



III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

52. **The project was conceived under the Metro Line 4 Phase 1 Project which influenced project preparation.** On the positive side, it meant that preparation could be faster as the works were the continuation of the previous engagement, they had already been identified since 2002, and the success of Phase 1 provided a clear rationale for the continuation of World Bank engagement. However, it also meant that there was little room to accommodate any changes in implementation strategy. There were three main factors affecting preparation consequently:

- (a) **Previous decisions affected the sequencing of the works and increased the complexity of working in Phase 2.** The phasing out of the overall Line 4 project into two was the consequence of the limited indebtedness capacity of the SSP at appraisal of the Phase 1 Project in 2001. The decision to prioritize the construction of key stations that allowed the integration with existing lines (Luz, Republica, Paulista, Pinheiros) in Phase 1, instead of sequencing the stations, responded to the uncertainty of financing for Phase 2. As a consequence, the sequencing of the civil works was determined during Phase 1, and minimum change was possible during preparation of Phase 2. The difficulty of constructing stations in the middle of an operating line became clear only during implementation. This was particularly true for stations that included new mezzanines (Sao Paulo-Morumbi and Higienopolis-Mackenzie). For instance, Fradique Coutinho, for which the mezzanine was partially built during Phase 1, was much easier to complete and was the first station of Phase 2 to be completed (in 2014).
- (b) **The timeline for implementation was accelerated.** To avoid paralysis of the works in the remaining stations of Line 4 as the line was starting operations, it was decided that the bidding process for the civil works of Phase 2 would be carried out with minimum possible delay. Partly because of this, the process was launched with Basic Project Designs instead of relatively advanced DDs. *Metrô* was to be responsible in the following years to finalize DDs instead of having them incorporated in the civil works contracts, affecting implementation later.⁴² This decision led to a delay in implementation as DDs were not completed for almost two years.
- (c) **Suspensions of corruption influenced key decisions.** Phase 2 was prepared during the eve of the *Lava Jato*,⁴³ which influenced procurement decisions during preparation to limit any negative impact from possible corruption. For instance, it was decided that the contractor of Phase 1 (*Odebrecht*) would not be automatically considered for Phase 2 because there

⁴² There were many factors influencing this decision, see section III.B.

⁴³ The *Lava Jato* refers to Brazil's largest criminal investigation in its history during which 11 major construction companies in Brazil were investigated and many also processed for contract overpricing, bribery, and money laundering. By June 2015, 42 executives from Brazil's biggest construction companies had been jailed, almost 2,500 judiciary processes were open overall with 204 jail sentences against 134 people and involving 16 different companies.



was suspicion that they would try to increase prices to compensate for the lower prices they had bid to win the turnkey contract for Phase 1.

- (d) **Risk aversion prevailed due to an accident in construction that occurred in Phase 1.** An accident during the construction of Phase 1 stations (Pineiros) and tunnels (with seven fatalities) created an environment of risk aversion that influenced the choice of contract. Contrary to Phase 1, it was decided that DDs were not to be included in the package of the civil works contracts. *Metrô* staff felt compelled to regain oversight by using a unit prices contract for the civil works, whereby each design and price divergence needs to be approved by the relevant juridical and auditing instances of *Metrô*, while outsourcing the DDs to consultants that they would supervise. As discussed later, this choice would impact implementation.

B. KEY FACTORS DURING IMPLEMENTATION

53. Most major factors that negatively affected the implementation of Line 4 Phase 2—notably the two main civil works contracts—were external factors outside of the World Bank or implementing agencies' control:

- (a) **Contractual impasses and procurement-related delays that could not be foreseen.** As mentioned in paragraph 23, there were significant delays due to contractual and procurement-related impasses that led to two restructurings. The most significant of these difficulties was the cancellation of the two main civil works contracts with the first winning consortium in 2015. The company rapidly faced problems due to its limited working capital and slowed down works until their complete stagnation by December 2014. The contracts had to be cancelled in 2015 and rebid. Overall, this process resulted in an approximately 18-months delay.⁴⁴ The delay was the consequence of the normal procurement procedures under the circumstances of a highly sensitive context, given the ongoing corruption scandals in the construction sector. Additional delays also occurred due to contractual conflicts with the firm operating Line 4. These conflicts resulted in alternative schedules having to be used with much of the works needing to be carried out at night or during limited periods of the day. Limited experience with this type of contracts, whereby the O&M of the line was privately concessioned (it was the first for Sao Paulo Metro), prevented the implementing agency from foreseeing any of these future bottlenecks.
- (b) **Construction-site contamination.** Civil works in the station Sao Paulo-Morumbi were delayed by 8 months due to the unexpected contamination of the soils that needed to be treated for construction. The station was planned in an area that formerly hosted a gas station. While legally the gas station had stated that it had four buried tanks for fuel storage, when excavations started three additional tanks were found. These three illegal tanks implied a higher contamination of the soil and delayed civil works by 8 months due to the necessary treatment.

⁴⁴ The delay was the normal delay by following strict procurement guidelines of the World Bank. They also include the fact that during the rebidding of the contracts, the first company had to be disqualified, and the second was chosen instead.



- (c) **Difficult political and macroeconomic conditions.** The *Lava Jato* investigation which started on March 2014 explains part of the delays in construction and contractual procedures. Large Brazilian construction companies were banned from competing in the rebidding process and smaller companies that were allowed faced limited working capital ratios. Additionally, procurement processes were rigidified as a consequence of the corruption scandal, leading to more cumbersome decision-making processes (that is, civil servants became liable for their personal assets). The winning consortium of the second civil works contracts, that is following those cancelled (2016–ongoing), faced the consequences of this fragile environment, while being itself a smaller company with limited cash flows. For example, it struggled to get the financial guarantee to start civil works and was obliged to leave 60 percent of the contract advance payment in the bank account to obtain it. As a consequence, this meant that it was able to open fewer work fronts simultaneously and implementation progressed slower than originally planned.
- (d) **Trickle down effects of delays in civil works in systems installation.** The supply of escalators, energy and telecom systems for the stations was significantly delayed during project implementation as multiple components needed to advance in parallel with the civil works, an intrinsic complexity of metro projects. For example, the escalators were ready for delivery but could not be installed without progress at the stations. Difficult negotiations had to be undertaken to avoid penalties.

54. Some factors that delayed construction were however under the implementing agency or/and Government control:

- (a) **Delays in receiving authorization for traffic management and construction sites.** These delays contributed to the first closing date extension by 22 months (2014 restructuring).
- (b) **Delays in final DDs that affected construction timeline and created conflicts.** The implementing agency's decision to start the first bidding process for civil works in 2012 only with basic project designs was responsible for significant delays. This was particularly so given that the civil works contracts were under unit prices. As a consequence, any change in design required an extensive technical and costing review process further analyzed by state control and auditing offices, and *Metrô* was not able to expedite this time-consuming process. The latter was further complicated in the fragile political environment that followed the *Lava Jato* investigation which increased the oversight by auditing offices. Had DDs been ready by the time of the bidding, interruptions due to unforeseen scope changes and consequent delays to approve them would have been minimized. Further, the lack of DDs prevented the earlier cancellation of the contract with the first consortium, which claimed it could not advance because of slow decision making by *Metrô*.
- (c) **National and state jurisdictional instances failed to recognize World Bank procurement rules over local laws.** Despite World Bank insistence and trainings, as well as a knowledgeable implementing agency, local jurisdictional instances significantly resisted the use of World Bank procurement rules and consistently sought to follow the local law (Lei 8666 or new Lei 13303). This implies important delays and contractual impasses in civil works contracts that could be resolved easily under a FIDIC contract. In Brazil, jurisdictional



instances such as the *Tribunal de Contas* at the state and federal levels ultimately supervise public expenditures and they have systematically ruled using local laws and regulations. This problem, while not specific to Sao Paulo, has become an important bottleneck for civil works implementation in Brazil. For instance, the value-for-money in procurement processes is rarely accepted. A clause of provisional prices was included in the civil works contracts to avoid paralysis, whereby a provisional price can be agreed before an auditing/judicial decision on the final price is made. This mechanism also failed to take place because of local judicial/auditing resistance. Because of the *Lava Jato* investigation, there has been an overzealous resistance to apply rules other than the local processes.

55. There are two positive factors that have allowed the civil works to continue despite ongoing difficulties and unexpected struggles common to large civil works programs (refer to box 2).

- (a) **Organizational and institutional capacity of Metrô.** *Metrô* is a 50-year old company that has had significant experience in the construction and operation of metro lines (Metro Lines 1, 2, 3 at appraisal). While Line 4 presented important innovations, which included during Phase 1 the first PPP in Brazil for the O&M of a metro line and the use of a turnkey contract for civil works construction, the management of the project rested with experienced engineers and management teams. Generally, this meant they were able to support the project. While at some points during implementation⁴⁵ this support faltered, more recently due to changes in key teams and management, the capacity of *Metrô* has helped push forward the civil works, particularly by appointing key members to support project implementation more adequately during the second civil works contracts.
- (b) **Strong relationship between Metrô and the World Bank.** The World Bank has been supporting urban transport reforms in Sao Paulo for more than 20 years. This strong partnership with *Metrô* has allowed honest exchanges during crisis periods and trust and constructive dialogue that permitted the conclusion of almost all the civil works of Phase 2 despite negative circumstances. It also ensures the very likely completion of works by the end of the Line 5 project in 2020.

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

M&E Design

56. **Monitoring and Evaluation (M&E) was straightforward to capture the measurement of the development objectives chosen and reflected the focus on civil works predominant at the time of preparation.** The M&E captures the key measurement of the PDOs in terms of improved quality of service for public transport users in the area of influence of the stations built during Phase 2 and the integration with buses at these stations. Intermediate indicators were designed to measure the progress of the infrastructure construction and systems implementation at the stations and the Vila Sônia tunnel and

⁴⁵ Particularly during the first contract when key staff was occupied in the Line 5 project.



yard. Given that the institutional component was small, and mostly included the support of designs, there was no indicator to capture their progress. Strictly, the M&E framework was adequate with the intentions of the project at appraisal.

57. **While the M&E design allowed for appropriate supervision, some aspects could have been stronger.** The M&E was designed to strictly measure the PDOs, which were defined narrowly with a focus on improving quality of service for public transport users and the bus integration at the affected stations. While it allowed for adequate supervision, the M&E design could have been strengthened by providing greater detail on the definition of the indicators and the methodology used to calculate baseline. Still, this information was obtained with the Project Management Unit (PMU). Additional PDO indicators could have however been included to allow for better monitoring of the achievement of the PDO at closing. For instance, some aspects of users' satisfaction surveys that were used to complement information could have been part of the Results Framework. Similarly, intermediate indicators for the institutional strengthening component (Component B) were absent. While this component was very small and designed to support civil works completion, an intermediate indicator related to the PMOC contract for instance could have been included to properly monitor this component.

M&E Implementation

58. **M&E was implemented smoothly by the PMOC and the PMU.** The data for M&E were collected by the PMU and reported semiannually in progress reports. In parallel, the PMOC also provided monthly progress reports that closely accompanied civil works progress. Because M&E was straightforward and the PMU and the PMOC were experienced and adequately staffed, the M&E implementation went well. There was no modification to the Results Framework during implementation other than revising the end targets to reflect changes in schedule following delays in civil works.

M&E Utilization

59. **While M&E was utilized well to monitor project performance, it failed to go beyond project monitoring and become a tool for measuring longer-term development objectives.** Both the client and the World Bank team provided strong supervision on M&E through project implementation to keep consistency and monitor the progress of civil works and systems. This is evidenced by regularly updated actual data on indicators in the Implementation Status and Results Report to monitor project progress, which were consistent and sustained during the entire life cycle of the project. The update of end targets following restructurings and delays was also properly carried out. In particular, the forecasted demand at stations was recalculated to account for the impact of Line 5 and a slower integration with buses during the second restructuring of the project; end targets were also revised to reflect appropriate changes in schedule. Further, as mentioned, an effort was carried out to complete an IE of the metro line (Phase 1).⁴⁶ While the overall results were limited given the contamination of the control group (which was influenced by treatment), the data still allowed the determination of some positive findings and informed an improved design for the IE of Line 5.

Justification of Overall Rating of Quality of M&E

⁴⁶ Impactos da Linha 4 Relatório Final março 2015.



60. The overall rating of quality of M&E is Modest. While the project M&E quality adequately measured the PDOs and monitored implementation progress, indicators were sometime loosely defined. While part of the Results Framework was improved during the second restructuring (new demand at stations and updated end targets), the changes responded more to modifications in implementation schedule than reforming the structural shortcomings. There were no intermediate indicators for the institutional components, however small they were. Still, the implementation was smooth, and utilization was effective to inform project management and decision making.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

Environment and Social

61. **Environmental and social safeguards were correctly implemented.** The original project was classified as a category 'A' project, triggering safeguard policies on Environmental Assessment (OP/BP 4.01) and Involuntary Resettlement (OP 4.12). All safeguards instruments were prepared according to World Bank guidelines (including Resettlement Action Plans for affected properties). While the project complied with all the World Bank safeguard policies throughout the project implementation period, in 2016 the safeguards supervision downgraded the environmental assessment to Moderately Unsatisfactory. The downgrade resulted from the slowdown in construction sites and their abandonment after the first contract was cancelled in 2015; during this period the difficulty in obtaining data for monitoring compliance prompted the downgrade. The situation was rectified with the signing of the new contract and the restart of construction in 2016. An inventory of the abandoned sites was carried out to confirm continued compliance. Social safeguards were well observed throughout Phase 2 with only 29 resettlements. These adverse involuntary resettlements were dealt with in an appropriate manner, with *Metrô* keeping an effective Grievance Redress Mechanism throughout the project life cycle.

62. **The PMU and the PMOC were generally well staffed with skilled social and environmental specialists.** Environmental and social specialists at the PMU and the PMOC generally worked proactively with the World Bank safeguard team members on minor issues regarding environment and social safeguard, including during the aforementioned period of the abandonment of construction sites.

Fiduciary

63. **No major issues with regard to financial management and procurement.** Fiduciary compliance was satisfactory throughout the project. The PMU was well staffed with skilled and experienced financial management and procurement staff, who worked proactively with the World Bank fiduciary team members on minor issues on financial reports and external audits.

C. BANK PERFORMANCE

Quality at Entry

64. **The World Bank ensured quality at entry by using experience from Phase 1 of the project and its long-term engagement in the public transport sector in the SPMR and through an adequate alignment of the project objectives with Government plans and the World Bank CPF.** The project benefited from experience and lessons learned from Phase 1 of the project and other World Bank-



financed rail projects. The technical approach included, among others, the following lessons that were properly followed: (a) ensuring that the service order of civil works was signed only after there was a clear deadline for the expropriations, (b) improving safety procedures and supervision at tunnel construction sites, (c) maintaining a close scrutiny of forecasted demand due to their inherent uncertainty, and (d) keeping a close monitoring of environmental impacts at construction sites. The project was also designed based on the state strategy for the sector, by emphasizing multimodal integration—with buses and bicycles—and in the framework of the 2008–2011 CPF.

65. **Given that contractual impasses and procurement delays could not be fully anticipated, the World Bank could not foresee the extent of delays during preparation of Phase 2.** As discussed in previous paragraphs, the project experienced delays that were largely related to two factors: (a) the lack of readiness of DDs during the bidding of the first civil works contract and (b) abandonments of civil works during the contractual impasses and contract cancellation of the first bidder. The World Bank could not anticipate any of the two. While DDs were not financed by the project, the implementing agency had fully committed to their completion before the award of the first civil works contract. Second, previous experience did not allow anticipation of any delays in concluding the DDs would have such a large impact.⁴⁷ This was exacerbated by the cash flow difficulties of smaller construction companies following the *Lava Jato* investigation and the change in oversight culture.

66. **The difficulties related to the phasing out of the project, with construction choices of Phase 1 affecting that of Phase 2, could not have been foreseen.** One complicating factor of the Phase 2 project has been the construction of stations in previously left shells in the middle of an operating line. Yet, it is hard to believe that this could have been anticipated during appraisal of Phase 1 by the World Bank team, when very complex construction projects and information on their failings was less readily available. Further, there was a need to accommodate the fiscal and financial capacities of the SSP.

67. **The World Bank team included price and physical contingencies that proved to be realistic.** Project cost estimations included contingencies of up to 19 percent of total project cost (14 percent for physical contingencies, 4 percent for price contingencies) at entry to account for possible shocks. These percentages were large but in line with best practices. They proved to be realistic: when considering these contingencies, cost overruns were small and only about 4 percent more compared to appraisal.

68. **The project supported the project management capacity of the implementing agency by ensuring the continuity of the PMOC at entry.** The PMU at *Metrô* was supported during the life cycle of Line 4 Phase 1 and Phase 2 by the same PMOC. While the PMOC was designed to act as an independent oversight unit directly reporting to the World Bank, it also supported and supports the PMU during weekly meetings and has been consulted for critical decision making due to its independent nature. The design of such an oversight unit at entry was very innovative at the time.

Quality of Supervision

69. **The World Bank team identified the problems with the slowdown of works during the first years of implementation and proactively tried to mediate a solution between *Metrô* and the first contractor**

⁴⁷ In previous projects where DDs were carried out by *Metrô* and contracted with large construction companies, there was a general understanding that the project could advance before DDs were ready and a price would be later agreed. Because large companies had enough cash flows, this practice was prevalent in the sector before the *Lava Jato* investigation.



before the cancelation of the first contract. The World Bank team identified as early as December 2013 that there were significant delays in construction schedule not only as a consequence of the slowdown of works by the contracted company but due to delays in final DDs, unexpected construction site conditions (gas station at Higienopolis-Mackenzie), and delays in traffic management plans. The World Bank advised the construction company and started to support implementation with close supervision of the progress of DDs. The World Bank also approved a restructuring of 22 months to accommodate for the new construction schedule. In 2014–2015, the project team undertook five missions where it interacted with the contractor, who manifested their intention to continue with the contract despite *Metrô's* interest to cancel it. For example, in March 2015, with World Bank assistance, both parties decided to continue with the contract and reached an agreement to establish a Dispute Resolution Board. The latter was meant to expedite the payment of the invoices and to analyze expeditiously contractor's claims, and the contractor was to mobilize all the necessary resources to execute the remaining works in 12 months. Ultimately a solution was not possible, and the World Bank gave its no-objection to *Metrô's* desire to cancel the first contract after a due diligence process in October 2015.⁴⁸ As such, while an earlier termination of the contract had been requested by *Metrô*, the World Bank had to ensure compliance with procurement guidelines, including evidence that the application of contractual remedies was being applied. The contract was terminated in December 2015. The construction of the remaining scope was rebid and a new contract signed in mid-2016.

70. **The World Bank team learned lessons from the first contract to supervise closely the second contract.** Lessons from the first contract termination were applied as early as during the bidding of the second contract. First, *Metrô* rebid the civil works with virtually completed DDs (95 percent); second, the World Bank included a procurement condition whereby the winning company would have to present a stronger financial guarantee, with 10 percent of the total value of the contract available at signing. This last condition was included to ensure the financial capacity of the company in the fragile post-*Lava Jato* context. Additionally, lessons learned were also incorporated during the close supervision of the second contract, particularly by including meetings with the awarded company during supervision missions to obtain a more candid description of project progress.

71. **The World Bank team provided constant support to the counterparts during project implementation.** Beyond the contractual impasses, the World Bank provided constant support to the counterparts during the entirety of project implementation as evidenced by supervision missions carried out at least twice a year, including safeguards supervision and project implementation oversight. Largely, this close support ensured the continuity of the project and the achievement and likely achievement of the PDOs. Two restructurings were carried out to respond to the delays in civil works. During these restructurings, the Results Framework was updated and the forecasted demand at stations recalculated when appropriate. The team responded with flexibility to the request to transfer the conclusion of Line 4 Phase 2 civil works and systems installation to the Line 5 project, acknowledging the fiscal difficulties of Brazil that would have prevented any additional financing under the original project. This flexibility has been key for the success of the project, but has sometimes also made the evaluation difficult, for example, there is no clear definition of the scope between what is financed under Line 4 Phase 2 and Line 5 and the Results Framework of Line 5 falls short of some of the aspects that should still be monitored under the

⁴⁸ Details are included in Operations Procurement Review Committee [OPRC] report 2113/CAN from 2015.



new project attribution. Close supervision and adequate transition periods between task team leaders ensured a strong relationship between the teams and the implementing agency.

Justification of Overall Rating of Bank Performance

72. The overall rating of World Bank performance is considered **Satisfactory**. There were shortcomings during preparation and implementation. However, the complexity of the project, the need to comply with strict World Bank procurement procedures, the close supervision and support that followed during the abandonment of works by safeguard specialists, and the strong supervision that allowed for the continuation of the project until its conclusion justify the satisfactory rating. Overall, the World Bank provided a solid performance in one of the most complex infrastructure projects financed by the institution, which involved many unexpected shocks—such as Brazil’s largest corruption scandal in its history (*Lava Jato*)—beyond the already complex urban setting of the SPMR. The following aspects can be highlighted: (a) proactive response to project restructuring, flexibility, and attention to detail (that is, recalculation of demand and EA); (b) continuous monitoring in safeguards and fiduciary areas; (c) strong partnership and continuous supervision missions; and (d) likely achievement of all project results.

D. RISK TO DEVELOPMENT OUTCOME

73. **There is limited risk at the time of completing the ICR that the development outcomes will not be achieved.** First, four out of five stations have been completed and transferred to the concessionaire (CVQ) for their operation. CVQ has shown a strong performance in the O&M of Line 4 to date—evidenced by recently having been awarded a 20-year contract for the operation of Line 5—and there is no reason to believe the contract which is set to end in 2036 would be terminated earlier. The contractual obligations and positive record of the company ensures the high-quality O&M of the line in the years to come. Second, remaining civil works—mainly Vila Sônia station, its bus terminal, tunnel, and yard—are on track to be achieved by 2020 under the Line 5 project, ensuring the sustainability of financing, supervision, and institutional commitment. While the project is not completely insulated from macroeconomic shocks that could affect the cash flows of the contracted construction company and slow civil works, this risk is deemed to be low. Third, tariff integration has been solidly institutionalized during the last 10 years, which ensures multimodal integration at Line 4 Phase 2 stations. Promoting urban sustainable mobility has been one of the main pillars of the city’s 16-year Strategic Master Plan developed in 2014, which included bold actions such as the introduction of parking minimums, the promotion of the biking culture, and investments in mass transit. Some of these actions have already materialized showing the commitment of the city to its sustainable mobility agenda. All these support the sustainability of the Development Outcomes.

74. The Theory of Change remains fully achievable due to the sustainability provided by restructuring of Line 5 to incorporate the remaining activities needed to complete Line 4. The PDO and Results Framework of the Line 5 project now account for these outcomes.

V. LESSONS AND RECOMMENDATIONS

75. **The complexity of the implementation of Sao Paulo Metro Line 4 Phase 2, which spanned a period of 8 years, offers a rich set of lessons learned.** They are summarized as follows:



- (a) **DDs and the choice of contracting model need to be carefully analyzed.** The lack of advanced DDs before the bidding of the first civil works contract, together with the choice of using a unit prices model, was one of the main bottlenecks during project implementation.
 - (i) It is key to have almost full DDs before the bidding of civil works. Bundling DDs with the civil works contract can be a good alternative, as the contracted construction company has the right incentive to ensure their timely completion. Advanced basic project designs are needed in this case.
 - (ii) The choice of contracting model needs to be carefully analyzed by considering local idiosyncrasies and judicial barriers. The delays of implementation and contractual impasses of Phase 2 provide a clear rationale for the use of turnkey contracts in contexts with high levels of red tape and when including the necessary checks and balances.
 - (iii) Contracting penalties and clauses need to be designed so that they fulfil their intended use. Understanding the local culture when designing contractual penalties and clauses is important so that these are applied accordingly.
 - (iv) The advance payment which was set up to ease working capital for the contracted company was a good tool, but it needs to be earmarked to ensure it will be used for the project.
 - (v) A full inventory and proper analysis of the additional costs of restarting works once working fronts have been abandoned for long periods is necessary before agreeing a new contract.
- (b) **The sequencing of civil works is important.** Building stations in the middle of an operating line in a highly dense urban area will likely imply delays, particularly when stations are complex (that is, mezzanine). Contractual clauses to allow construction during flexible schedules are essential when the line is privately operated. Additionally, delays in the completion of civil works can lead to delays in systems installation due to their sequenced nature. Contemplating flexibility in initial systems contracts is important to avoid penalties.
- (c) **Project management.** The use of a PMOC to advise task teams is important to ensure continuity and ongoing supervision in complex long projects. As an independent oversight unit, the PMOC can inform the teams of ongoing problems, delays, and bottlenecks; advise the implementing unit when needed; and ensure sustainability through time. To succeed, the PMOC needs to work collaboratively with the PMU and avoid being perceived as a policing unit. For instance, given that *Metrô* staff ultimately has full accountability toward noncompliance and safety issues, the PMOC was sometimes perceived as susceptible to increase their reputational risk. As a result, transparency when sharing information was not always ensured, which limited their capacity to work proactively.
- (d) **Multimodal integration is only possible if coordination and tariff integration takes place.** The physical integration of Phase 2 stations with other metro and CPTM lines and buses—



that is by having bus terminal within the stations or at a walking distance from the stations— allowed the large estimated passenger demand to materialize. Yet, while physical integration is key, the backbone behind the success has been the existing tariff integration that ensures seamless transfer. Multimodal integration needs to rely on tariff integration to succeed.

- (e) **Flexibility is important in all aspects of complex projects.** Complex large infrastructure projects in dense urban areas will very likely face difficulties. Flexibility to incorporate changes, adapt, and accept errors in all aspects of the project timeline from conception to implementation is key to achieve their completion. New World Bank procurement rules have been adjusted to this end, now allowing the competitive dialogue or Alternative Procurement Arrangements when appropriate. World Bank instruments such as the Multi-Phase Programmatic Approach or the Series of Projects are also more tailored to the longer timeline and phased approach needs of complex infrastructure projects.



ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: Improve the quality of service provided to the urban transport users in the area of influence of the new Line 4 stations (S.Paulo-Morumbi, Fradique C., Oscar Freire, Higienópolis-M., Vila Sonia).

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Quality of service objective: Travel time plus average waiting time between pairs of stations (in minutes, at peak hour)	Minutes	55.00 30-Dec-2009	20.00 25-Mar-2010	40.00 28-Feb-2018	32.00 31-Oct-2018
a. Vila Sonia - Luz	Minutes	55.00 30-Dec-2009	20.00 25-Mar-2010	40.00 28-Feb-2018	32.00 31-Oct-2018
b. Fradique Coutinho - Luz	Minutes	26.00 30-Dec-2009	10.00 25-Mar-2010	11.00 28-Feb-2018	11.00 31-Oct-2018
c. Higienopolis/Mackenzie - Luz	Minutes	13.00 30-Dec-2009	5.00 25-Mar-2010	6.00 28-Feb-2018	6.00 31-Oct-2018

Comments (achievements against targets): At Project closing in February 2018, the revised target of 40 minutes was achieved for the segment



Vila Sonia-Luz. The actual achieved at ICR was 32 minutes once the station Sao Paulo Morumbi opened on October 27, 2018. The original target of 20 minutes, revised to be 22 minutes due to calculations errors in the RP 2016, will be achieved in 2020 under Line 5 Project financing (P116170) once Vila Sonia station is complete in 2020. Time between Via Sonia-Luz will be tracked through a PDO indicator in the Results Framework of Line 5 Project. The sub-indicators between Higienopolis-Mackenzie Luz and Fradique Coutinho Luz achieved their targets set for 2018. Their original target was slightly revised due to calculation errors (+1 minute).

Objective/Outcome: Facilitate the integration between metro and bus at those stations

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Integration objective: Percentage of 5 new stations integrated with bus lines	Percentage	0.00	100.00	91.00	91.00
		21-Dec-2009	25-Mar-2010	28-Feb-2018	31-Oct-2018

Comments (achievements against targets): This PDO-2 indicator was fully achieved against the revised target of 91% for 2018, with all operating stations achieving physical integration with buses. The target was revised in 2016 to exclude Vila Sonia when it became clear that this station would only be ready in 2020. The original target of 100% will be achieved in 2020, once this station is operational.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Accessibility objective: Total annual passenger boardings in new stations (both directions, in millions)	Number	0.00	0.00	0.00	0.00
		21-Dec-2009	25-Mar-2010	28-Feb-2018	31-Oct-2018
b. Morumbi	Number	0.00	17.10	8.50	0.00
		30-Dec-2009	25-Mar-2010	28-Feb-2018	31-Oct-2018



c. Fradique Coutinho	Number	0.00 30-Dec-2009	10.60 25-Mar-2010	3.90 28-Feb-2018	3.80 31-Oct-2018
d. Oscar Freire	Number	0.00 30-Dec-2009	10.80 25-Mar-2010	7.20 28-Feb-2018	7.20 31-Oct-2018
e. Higienopolis/Mackenzie	Number	0.00 30-Dec-2009	11.30 25-Mar-2010	9.90 28-Feb-2018	10.00 31-Oct-2018
a. Vila Sonia	Number	0.00 30-Dec-2009	47.00 25-Mar-2010	26.50 31-Dec-2020	0.00 31-Oct-2018

Comments (achievements against targets): Total annual boardings were successfully achieved (or are projected to be successfully achieved) against revised targets for 2018 closing for all stations (see the comment below on station Sao Paulo-Morumbi that became operational in October 2018). The targets were revised in 2016 during a restructuring to reflect changes in implementation timeline, new demand projections based on the OD Survey 2007, which was not available at appraisal (1997 was only ready by then), and to incorporate the impact of the start of operations in Line 5. This information was not available at appraisal which implied an overestimation of demand at some stations. While the targets were revised, it did not result from reducing the scope of the project (as explained in the main text). At ICR, all targets were achieved at stations Fradique Coutinho, Oscar Freire and Higienopolis Mackenzie. While the actual value for Sao Paulo-Morumbi is zero, demand observed at the station after the first week of operation (27 thousand daily boardings) supports the achievement of annualized demand against the revised outcomes for the 2018 closing. More ambitious targets set out during the 2016 restructuring for when the line would be completed in 2020, will be achieved by that date when Vila Sonia becomes operational. Full details are available in Section B of the ICR.



A.2 Intermediate Results Indicators

Component: Civil works & Equipment

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Cumulative % of completion of Vila Sônia Tunnel	Number	0.00	100.00	77.00	76.56
		21-Dec-2009	25-Mar-2010	28-Feb-2018	30-Sep-2018

Comments (achievements against targets): Completion rate of the Vila Sonia Tunnel was at about 76 percent, practically on target, as of September 2018. The target was revised in 2016 to accommodate the civil works delays due to contractual impasses. The 100% original target will be achieved at closing of the P116170 Project in December 2020.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
cumulative % of completion of Vila Sônia Station	Number	0.00	100.00	76.00	28.62
		21-Dec-2009	25-Mar-2010	28-Feb-2018	30-Sep-2018

Comments (achievements against targets): Completion rate of the Vila Sonia station is at about 29% as of September 2018 compared to the targeted 76% by 2018 due to delays in the schedule of civil works. The original target of 100% will be achieved under the L5 Project (P116170) by 2020, and was formally included in the Results Framework of Line 5.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
cumulative % of completion	Number	0.00	100.00	100.00	81.40



of Vila Sônia yard		21-Dec-2009	25-Mar-2010	28-Feb-2018	30-Sep-2018
--------------------	--	-------------	-------------	-------------	-------------

Comments (achievements against targets): Completion rate of the Vila Sonia yard was at about 81% as of September 2018 compared to the targeted 100% by 2018. The target was not formally revised at the time of the restructuring. The original target will be achieved under the L5 Project (P116170) by 2020 and was formally included in the Results Framework of Line 5.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
cumulative % of completion of existing stations (finalization)	Number	0.00	100.00	100.00	94.61
		21-Dec-2009	25-Mar-2010	28-Feb-2018	30-Sep-2018

Comments (achievements against targets): All 4 stations are virtually completed and operational, with the last one having started operations in October 2018. 78% of these four stations was completed by February 2018. By October 2018, the completion rate had reached 94.61%. This percentage reflects the fact that Oscar Freire station's Clinicas Access (one of the entrance gates) and the bus terminal at Sao Paulo Morumbi were included as part of the station completion rate and they will be finalized in December 2018. Their completion remains highly likely with individual completion rates at 92.85% for Oscar Freire, and 97.6% at Sao Paulo Morumbi as of end October 2018.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
cumulative % of completion of systems	Number	0.00	100.00	73.00	68.13
		21-Dec-2009	25-Mar-2010	28-Feb-2018	30-Sep-2018

Comments (achievements against targets): Completion rate of the systems was about 68% as of September 2018 compared to the targeted 73 percent. The original target of 100% will be achieved under the L5 Project (P116170) once Vila Sonia station is completed in December 2020.





B. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1: Improve the quality of service provided to the urban transport users in the area of influence of the new Line 4 stations (São Paulo-Morumbi, Fradique Coutinho, Oscar Freire, Higienópolis-Mackenzie, and Vila Sônia)	
Outcome Indicators	<ol style="list-style-type: none"> 1. Travel time plus average waiting time between pairs of stations (in minutes at peak hour), specifically between Vila Sônia-Luz; Fradique Coutinho-Luz; Higienopolis-Mackenzie-Luz. 2. User satisfaction with Line 4 operations after the opening of the new stations; including the purpose for boarding/alighting at Line 4 Phase 2 stations, overall quality of service, reliability, and comfort of trains (extra indicator) 3. Accessibility to jobs defined as the % of jobs accessibility within 1-hour commute from district of residence in the area of influence of Line 4 Phase 2 stations, (extra indicator).
Intermediate Results Indicators	<ol style="list-style-type: none"> 1. Cumulative % of completion of Vila Sônia Tunnel 2. Cumulative % of completion of Vila Sônia Station 3. Cumulative % of completion of Vila Sônia yard 4. Cumulative % of completion of existing stations (finalization of 4 stations) 5. Cumulative % of completion of systems (STD, SCAP, PSD, SAL, Aux. Telecom).
Key Outputs by Component (linked to the achievement of the Objective/Outcome 1)	<ol style="list-style-type: none"> 1. Completion of 4 out of 4 stations for which the shells were opened during Phase 1. 2. All 4 out of 4 stations are operational as of end October 2018. 3. Significant progress in Vila Sônia tunnel, station, and yard; expected to be completed under Line 5 financing by 2020.
Objective/Outcome 2: Facilitate the integration between metro and bus at those stations	
Outcome Indicators	<ol style="list-style-type: none"> 1. Percentage of 5 new stations integrated with bus lines. 2. Total annual passenger boardings in new stations (both directions, millions), at Sao Paulo-Morumbi, Fradique Coutinho, Oscar Freire, Higienopolis-Mackenzie, Vila Sônia. 3. Percent of passengers in new Phase 2 stations resulting from transfers (all modes) (extra indicator) 4. Number of passengers lost year-on-year on buses along the corridor of Metro Line 4 after the opening of the new stations (extra indicator).



Intermediate Results Indicators	1. Same as above.
Key Outputs by Component (linked to the achievement of the Objective/Outcome 2)	<ol style="list-style-type: none">1. Bus integration achieved by physical integration at constructed stations at all 4 completed stations; Vila Sonia integrated by 2020.2. Bus terminals 97.6% completed at Sao Paulo-Morumbi, expected to be ready by December 2018. The Vila Sônia bus terminal is expected to be completed in 2020 (72% constructed).3. Transfers from other modes possible due to physical and tariff integration at completed stations (extra indicator).

**ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION****A. TASK TEAM MEMBERS**

Name	Role
Preparation	
Jorge M. Rebelo	Task Team Leader(s)
Miguel-Santiago Da Silva Oliveira/ Susana Amaral	Financial Management Specialist
Maria Isabel Junqueira Braga	Environmental Safeguards Specialist
Reidar Kvam	Social Safeguards Specialist
Catarina Portelo	Counsel
Georges Darido	Team Member
Bernardo Guatimosim Alvim	Team Member
Ricardo Marar	Team Member
Supervision/ICR	
Bianca Bianchi Alves, Gregoire Francois Gauthier	Task Team Leader(s)
Frederico Rabello T. Costa	Procurement Specialist(s)
Susana Amaral	Financial Management Specialist
Jorge M. Rebelo	Team Member
Alberto Coelho Gomes Costa	Social Safeguards Specialist
Catarina Isabel Portelo	Counsel
Hanayo Taguchi	Team Member
Michele Martins	Team Member
Bernardo Guatimosim Alvim	Team Member
Nathalie Picarelli	Team Member
Marcio Cerqueira Batitucci	Environmental Safeguards Specialist
Fabio Hirschhorn	Team Member

B. STAFF TIME AND COST



Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US\$ (including travel and consultant costs)
Preparation		
FY08	.375	2,976.48
FY09	11.354	128,158.08
FY10	13.376	95,858.84
Total	25.11	226,993.40
Supervision/ICR		
FY10	.200	5,979.19
FY11	12.672	82,302.35
FY12	15.428	48,593.75
FY13	27.498	128,686.10
FY14	30.799	38,992.92
FY15	31.425	63,119.24
FY16	30.715	152,841.91
FY17	19.962	113,080.08
FY18	14.372	98,619.12
FY19	1.186	17,841.62
Total	184.26	750,056.28



ANNEX 3. TOTAL PROJECT COST BY COMPONENT

Components	Amount at Approval (US\$, millions)	Actual Estimation at Project Closing (US\$, millions) b	Percentage of Approval (%)
Component A: Infrastructure and Equipment Investment	471.438	526.181	111.6
Component B: Technical Assistance	32.664	33.476	102.5
Unclassified	-	69.074	—
Total	504.102^a	629.056	124.8

Note: a. Excludes physical and price contingencies that would make the total amount US\$600.585 million; b. Including also costs financed by Line 5 Project.

Table 3.1. Project Components and Cost Estimation at Appraisal

Project Components	Cost at Appraisal (US\$ million)				
	Project Cost	IBRD Financing	JBIC Financing ^a	Counterpart Funding	% IBRD Financing of Total Cost
	Component A - Infrastructure and Equipment	471.438	100.954	100.954	269.530
A.1 Expropriations	11.481	—	—	11.481	0.00
A.2 Systems Supplementary	11.764	—	—	11.764	0.00
A.3 Civil Works	331.899	87.49	87.49	156.919	26.36
A.3.1 Yard and Stations Finishing, and Vila Sônia Terminal Bus Station	88.103	23.225	23.225	41.653	26.36
A.3.2 Vila Sônia Stations and Extension	243.795	64.265	64.265	115.265	26.36
A.4 Systems	114.490	13.060	13.060	88.370	11.41
A.5. Borehole Characterization test and Special Geotechnical Test	0.509	0.114	0.114	0.281	22.40
A.6. Instrumentation	1.295	0.290	0.290	0.715	22.39
Component B. Technical Assistance	32.664	7.350	7.350	17.964	22.50
B.1. Civil Works Executive Design	16.620	4.765	4.765	7.090	28.67
B.2. Technical Assistance - Analysis of Civil Works Designs	1.389	0.311	0.311	0.767	22.39
B.3. Technical Assistance - Concrete Technological Control	0.497	0.111	0.111	0.275	22.33
B.4. Technical Assistance - Analysis of Systems Design	5.834	0.653	0.653	4.528	11.19

Project Components	Cost at Appraisal				
	(US\$ million)				
	Project Cost	IBRD Financing	JBIC Financing ^a	Counterpart Funding	% IBRD Financing of Total Cost
B.5. Technical Assistance - Material inspection and Assembly	3.153	0.353	0.353	2.447	11.20
B.6. Technical Assistance - Environmental Control	0.971	0.217	0.217	0.537	22.35
B.7 Project Management Oversight Consultant (PMOC)	4.200	0.940	0.940	2.320	22.38
Total Baseline Costs	504.102	108.304	108.304	287.494	21.48
Physical Contingencies	70.889	15.805	16.130	38.953	
Price Contingencies	25.592	5.565	5.565	14.463	
Total Project Costs	600.585	129.675^b	130.000	340.910	21.59

Note: a. JBIC co-financed the project; at appraisal it was expected to provide as much financing to Components A and B of the project as the World Bank.

b. Including the IBRD front-end fee (0.25 percent; equivalent to US\$0.325 million) the total financing required from IBRD was US\$130 million.

Table 3.2. Completion Rate of Project Components by IBRD Financing Sources

Components/Financing source	IBRD Line 4 Project	IBRD Line 5 Project	Total Expected by 2020
Component A: Infrastructure and Equipment Investment (% completion)	62	38	100
Component B: Technical Assistance (% completion)	67	33	100

Note: See Annex 5, data obtained from Client's ICR; Completion achieved by component at closing of the Line 4 Project and expected to be covered under the Line 5 Project.

ANNEX 4. EFFICIENCY ANALYSIS

1. At appraisal, the EA for the original project included an analysis of the incremental investment of Phase 2 and for the comprehensive investment in Line 4 (Phases 1 and 2). For that purpose, the implementing agency estimated, through demand modeling, the passenger-hours and passenger-km with and without the project and converted them into time savings and operating cost savings. An estimate for the reduction of accidents and road-based vehicle emissions was also added. The appraisal EIRR for the incremental investments of Phase 2 was estimated at 7.57 percent, for an NPV US\$46.802 million at a discount rate of 7 percent. The benefits-to-cost ratio was 1.04. For the entire line it was estimated at 15.57 percent, for an NPV of US\$824.727 million at a discount rate of 10 percent.⁴⁹
2. The project was restructured in 2016 to extend the closing date by 22 months. At the time, an EA was carried out using the updated OD Matrix (OD Survey 2007), which was not ready at appraisal (1997 data were used instead),⁵⁰ to account for the impact of the opening of Metro Line 5 on the demand of Line 4 stations. As a result, demand was redistributed among Phase 2 stations.⁵¹ The RP EA estimated the incremental investment of Phase 2 only but excluded Fradique Coutinho which was already opened in 2014. The without-project scenario included all built Line 4 stations. By these results, the estimated EIRR of Phase 2 was 9.37 percent with a discount rate of 6 percent and obtained a total NPV of US\$439.1 million.
3. The ex post economic evaluation follows the methodology used for the EA in the RP 2016 (Report No: RES18682); that is, it is an incremental analysis of Phase 2 investments only, given that the entire project (Phases 1 and 2) is not completed. The full exercise should be carried out at closing of the Line 5 project in 2020. The ICR EA includes Fradique Coutinho given that the ICR examines the full investment of Phase 2. Compared with the analysis carried out in 2016, the main update of this ICR EA is changes in the overall estimated costs and marginal updates to the demand at newly operating stations (table 4.1). The 2016 EA already expected that the Vila Sônia station would only start operating in 2020. Because the demand at the operating stations materialized as planned, and the forecasted demand for Vila Sônia and Sao Paulo-Morumbi has not changed since, the benefits vary only slightly from that of 2016.

Table 4.1. Sao Paulo Line 4 Total Annual Boardings, Both Directions, Per Station (passengers in millions) as Estimated in RP 2016 for 2018 and 2020, and at ICR

Stations	PAD (2010)	RP (2016)		ICR	
	At closing	Estimate 2018	Estimate 2020	2018	Estimate 2020
Vila Sônia	47	0	26.5	0	26.5
Sao Paulo-Morumbi	17.1	8.5	9.3	8.6 ^a	9.3

⁴⁹ At appraisal, a 10 percent discount rate was customary and at that rate the NPV from the incremental investment was negative. It was thus not presented in the PAD. An annex was filed in the Portal.

⁵⁰ As a consequence, the review of the transport demand model by the implementing agency involved the following activities: (a) network simulation review; (b) review of investment flows as reported by the PMU; and (c) calculation of the internal rate of return considering updated unit costs and operational parameters of the transport system.

⁵¹ The modelled changes were because some passengers who would prefer to take Line 4 would still use Line 5 because of the fare integration and physical integration through CPTM Line 9 and Pinheiros station.



Fradique Coutinho	10.6	3.9	5.5	3.8	5.5
Oscar Freire	10.8	7.2	7.4	7.2	7.4
Higienópolis/Mackenzie	11.3	9.9	10.6	10	10.6
Total	96.8	29.5	59.3	29.6	59.3

Note: Sao Paulo Metro Planning Department, based on the Transport Model updated with the 2007 OD Matrix.

a. Estimates for Sao Paulo-Morumbi 2018 are annualized values based on observations from the first weeks of operation.

A. Methodology

4. The methodology is unchanged and involves comparing the situation with and without the project, and quantifying **the benefits** due to:

- (a) Travel time savings for users of other transport modes. This impact is measured by estimating travel time differences with and without the implementation of the project. The value of time is as explained below (table 4.2);
- (b) Operating cost savings for all modes;
- (c) Road maintenance cost savings;
- (d) Traffic accidents savings; and
- (e) Air pollution savings (GHG emissions and other air pollutants).

Benefits from (a) to (e) are measured as they were done at appraisal (PAD) and for the RP 2016.

5. **Project costs.** The main costs are from:

- (a) The investment cost of Phase 2 of Line 4 as expected at the closing of the ICR (annex 3), for which a conversion factor of 94.6 percent was applied to account for transfer payments due to taxes and other transaction costs, as was done at appraisal and restructuring; and
- (b) The operating costs for the fleet and system operations.

6. Depreciation assumptions were, as at appraisal, for a useful life of 32 years.

7. **The Demand Forecast Model.** The demand model—estimated using a standard four-step model—was updated in 2016 by the implementing agency (*Metrô*) by revising the transport model with the updated OD Survey (2007) data and modelling induced change from private vehicles, while also considering the impact on the demand of Line 4 because of the opening of Line 5 stations. The travel mode share obtained is unchanged (table 4.2).

Table 4.2. Travel Mode Share (%)

Travel Purpose	Metro	Bus	Rail	Car
Home to Work	63.1	58.7	74.8	47.4
Business	10.8	13.3	6.9	19



Other	26	28	18.3	33.6
-------	----	----	------	------

Notes: Sao Paulo Metro Planning Department, based on the Transport Model updated with the 2007 OD Matrix; RP (2016).

8. The new estimated demand of Metro Line 4 (Phase 2) was as explained in table 4.1; it has materialized as expected. The last two columns are used in the ICR EA.

9. **Scenarios for the Demand Forecast Model in this EA.** The demand was forecasted for the with- and without-project scenarios.

- (a) Without-project demand forecast: demand model runs as ‘business as usual’ (includes Line 4 Phase 1);⁵²
- (b) With-project demand forecast: demand model runs with the assumption that Line 4 will be in full operation in 2020 (Vila Sônia), and all other Phase 2 stations are operational in 2018; the demand redistributes between the travel modes in the areas that are influenced by Line 4.

10. **Value of time.** For consistency, the value of time used was the same as the one used for the EA of the RP 2016.

Table 4.3. Value of Time Distribution (US\$)

Travel Purpose	Metro	Bus	Rail	Car
Home to Work	2.49	1.89	1.25	4.49
Business	17.17	13.05	8.58	31.06
Other	2.49	1.89	1.25	4.49

11. **Expected non-quantifiable benefits also exist; some were discussed at appraisal.** In addition to the expected quantifiable benefits, the project also generated other substantial economic and social positive externalities that are difficult to quantify.

- (a) **Livability and public trust improvement.** Livability and public trust in local governments may have improved due to the provision of critically needed public transport infrastructure and the improvement of public space around stations. While the benefits from improved public spaces are difficult to monetize and attribute, international best practices show that such enhancements can improve quality of life and social cohesion.
- (b) **Employment generation.** Employment generation increased during the construction phase and during operation due to increased accessibility and economic development along the corridor.
- (c) **Satisfaction with public transport services.** Passenger satisfaction with public transport services increased due to improved efficiency, reliability (on-time performance), coverage,

⁵² The entire new segment of Line 5—Capao-Redondo/Chacara Klabin—will be fully operational by December 2018. There are no expectations that there will be changes in demand from this opening. However, this is not included, as there is no updated demand model. OD Survey 2017 data are being finalized in December 2018 and the calibration of the demand model will follow.



comfort, and accessibility of public transport services. This is evidenced in the passenger satisfaction surveys of Metro Line 4.

- (d) **Increased accessibility.** Accessibility of residential areas to resources and services, including jobs, schools and hospitals, increased. This is evidenced in the passenger satisfaction surveys (as discussed in the main text).

12. **Discount rate.** The ICR EA uses the discount rate of 6 percent. In the past, World Bank infrastructure projects often assumed a 10–12 percent discount rate (as was the case at appraisal when they used a 10 percent rate), but a much lower rate between 4 percent and 8 percent has been observed recently for large public transportation projects with long-lasting benefits.⁵³ A recent World Bank study also suggests lower discount rates for investment projects with similar characteristics in Peru and other countries of the region because social benefits materialize over the long run.⁵⁴ For these reasons, a discount rate of 6 percent was deemed appropriate. This rate was also used in the RP 2016.

B. Results

13. **Result summary for benefits.** The detailed results for the estimated benefits are presented in table 4.4. The results indicate that the benefits of the project mainly come from travel time savings which accounts for 48.24 percent of the total benefits, while operation cost savings for all modes is the second highest contribution that accounts for 25.2 percent.

Table 4.4 Estimated Benefits

(At discount rate of 6%)	Percentage
Travel time savings	27.3
Maintenance cost savings	16.3
Private vehicle operation costs savings	20.4
Accidents reduction	5.00
GHG and pollution reduction	7.89
Bus operation costs savings	22.5
Total benefits	100

14. **Results of the NPV and EIRR.** The evaluation horizon for the EA is 39 years (2010–2049), with capital investments and construction during the first 10 years. The results show that at the discount rate of 6 percent, the NPV of the project is estimated at US\$140.556 million, with the EIRR at 8.65 percent. The benefit-to-cost ratio of the incremental investment was 1.22. This EIRR and NPV are lower than for the RP 2016, and mostly reflect the differences such as adding Fradique Coutinho among the benefits and

⁵³ A recent review specific to urban rail projects in New York, London, and Toronto completed since 2000 revealed that these projects have used rates varying between 2.35 percent and 5 percent. Similarly, results are shown in a study for a set of metro projects in a few Organization for Economic Co-operation and Development (OECD) countries. Chile is currently using a discount rate of 7 percent for all infrastructure projects.

⁵⁴ A recent publication estimated a social discount rate for Peru ranging between 4.1 percent and 6.7 percent depending on future growth scenarios for the country (Lopez, Humberto. 2008. "The Social Discount Rate: Estimates for Nine Latin American Countries." Policy Research Working Paper 4639, World Bank, Washington, DC.).



updating the overall costs (including previously excluded sunk costs). The EIRR is however slightly higher than that estimated at appraisal, of 7.57 percent.

C. Financial Analysis

15. **A project financial analysis was performed at appraisal.** It compared total investments versus savings due to lower operating, maintenance, and management costs and higher revenues as a result of the project. No travel time savings or indirect benefits were considered, which explains the difference from the economic evaluation. The results of the financial analysis indicate a financial internal rate of return (FIRR) of 11.6 percent. Financial projections prepared for *Metrô* for 2010–2036 showed that the working ratio of the operating agency will be equal to or less than 1, and operating costs will therefore be below operating revenues.

16. **The same methodology was followed at the ICR stage.** The results of the financial analysis indicate an FIRR of 3.22 percent. While this number is much lower than at appraisal, it reflects that the FIRR calculated here is only for the incremental of Phase 2. Despite the difference the FIRR is still positive. The working ratio of the operating agency has been equal to or less than 1 for 2010–2018, and operating costs have therefore been below operating revenues.



ANNEX 5. SUPPORTING DOCUMENTS

ICR Sao Paulo Metro, <http://wbdocs.worldbank.org/wbdocs/dri/objectId/090224b0865f600b>



ANNEX 6. PROJECT TIMELINE of KEY EVENTS

