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Rapid rail transit system: A comparative financial performance between London (UK) and New Delhi (India)

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Abstract

The Rapid Rail Transit System (RRTS) plays a crucial role in urban mobility, offering fast and efficient transportation solutions. This study compares the financial performance of RRTS in London (UK) and New Delhi (India), analyzing key metrics such as revenue generation, operational costs, government subsidies, and profitability. London's transit system, operated by Transport for London (TFL), benefits from high fares, extensive ridership, and diversified revenue streams, including congestion charges and commercial activities. In contrast, New Delhi's metro system, managed by the Delhi Metro Rail Corporation (DMRC), relies on lower fare structures, government funding, and public-private partnerships to maintain sustainability. The study evaluates gross revenue, gross expenditure, Operating Expenses and Operating Income revenue and also analyse operating profit/loss of London Underground and Delhi Metro during 2002-03 to 2021-22. London's RRTS demonstrates greater self-sufficiency, driven by a well-integrated transport network and advanced ticketing systems. Meanwhile, New Delhi's model prioritizes affordability and accessibility, with long-term investments supporting expansion. Findings highlight the need for balanced fare policies, innovative revenue generation, and government interventions to ensure sustainable urban transport solutions.

Keywords: Rapid rail transit system, TFL-London, DMRC-India, Financial Performance

Introduction

No doubt roads are the veins for any Economy which ensures the factor mobility from one geographical location to another, but in present scenario of development of economies where development are born by rapid industrialisation and fast urbanisation Rapid Rail Transit System act as power booster for an economy. RRTS is not simply a transport system, it is advanced fast moving urban transport featured with modernised technology, runs on rail under the road as well on surface in elevated track, move a section of population in bulk and having efficient running management, RRTS is an alternative mode of urban transit shared path where roads are highly congested during peak hours and makes less adverse effect on environment. Still it requires huge capital investment and large amount of capital investment. Before recommending this approach for any economy, its financial performance must be analyzed to ensure its financial sustainability.

The financial performance of Rapid Rail Transit System (RRTS) reflects its ability to generate revenue, control costs, and maintain profitability by ensuring efficient management in operations. Revenue primarily comes from passenger fare box, ticket sales, ancillary services such as advertising or onboard services and other commercial activities at the stations premises. Key expenses include traction expenses, Rolling stock maintenance, driver and office staff salaries, interest cost of loan, insurance, licensing fees, and infrastructure costs. Profitability is influenced by factors such as fleet utilization, route optimization, and fuel efficiency. A high load factor (percentage of occupied seats) indicates effective capacity utilization, improving revenue per trip. The operating expense ratio helps measure cost efficiency, while the operating revenue ratio shows how much of the total income comes from fare box revenue. There are two factors which influenced financial performance of RRTS is External and Internal factors; Internal financial factors are those factors which

directly influence operating performance of RRTS and External factors like electricity price fluctuations, economic conditions, government regulations, and competition impact financial performance. Additionally, subsidies and public-private partnerships can provide financial stability. A financially successful RRTS company maintains a balance between affordability, service quality, and operational efficiency. Sustainable growth depends on optimizing resources, adopting technology-driven solutions, and adapting to evolving market demands.

Rapid rail transit system: London

Urban Rail Network in London is oldest rail network in the world which especially devoted for urban connectivity. The network comprises London underground rail network or The Tube, Dockland Light rail Network, London Overground, Elizabeth Line and Trams Rail which serves major socio-economic region of Greater London. Journey of Underground Railways start at 10th of January 1863, where a private company The Metropolitan Railway after getting charter of construction from the local authority start constructing first every urban metro project beneath the road network of London. In the 150 years of its journey it transformed into one of the marvellous technological urban transit infrastructures of all the time, also make it most scenic urban transport system for the London city. Initial wooden based steam locomotive are now completely transformed into advanced Aluminium based electric rolling stock. The early tube lines, initially owned by various private companies, were unified under the Underground brand in the early 20th century. In 1933, they were merged with the sub-surface lines and bus services to create London Transport, overseen by the London Passenger Transport Board (LPTB) Today, London Underground Limited (LUL), a subsidiary of Transport for London (TfL), operates the network. Fare collection started with Travelcard which was introduced in 1983, followed by the Oyster card in 2003. In 2014, London became the first public transport system to accept contactless bank card payments. The LPTB also commissioned modernist station buildings, posters, and public artworks. The schematic Tube map was recognized as a national design icon in 2006 which was designed by Harry Beck in 1931, and now incorporates other transport networks.

Rapid rail transit system: New Delhi

The Delhi Metro has played a pivotal role in transforming urban mass transportation in India. As the country's first modern, air-conditioned, and eco-friendly metro system, it has significantly enhanced commuter comfort and revolutionized public transit, not just in the National Capital Region (NCR) but across the nation. With an extensive network spanning approximately 395.248 km and 289 stations, including the NOIDA-Greater NOIDA Corridor and Rapid Metro in Gurugram, the Delhi Metro Rail Corporation (DMRC) has set a benchmark in infrastructure development. Despite the project's technical complexity, DMRC successfully completed it ahead of schedule and within the allocated budget, demonstrating efficiency and excellence in execution. Established on May 3, 1995, under the Companies Act of 1956, DMRC operates as a joint venture between the Government of the National Capital Territory of Delhi (GNCTD) and the Central Government. This partnership was formed to fulfill the vision of a world-

class Mass Rapid Transit System (MRTS) in Delhi, ensuring a seamless, reliable, and modern commuting experience for millions. Today, the Delhi Metro stands as a model for urban transportation development in India, inspiring similar initiatives in other cities (DMRC, 2024).

Features of rapid rail transit system

- Rail based transit system runs underground and in surface in elevated track.
- Average speed of run is 30km/hr to 45km/hr, can attain maximum speed of 100km/hr. Run with 4 to 8 rolling stock car
- Maximum carrying capacity is 1200 to 2400 passenger at a time by each rolling stock
- Fully electric, provided power by Overhead wire in Delhi and by Four rail track system in London underground.
- Fully air-conditioned with proper ventilation and Automatic door opening and closing which provide safety of passenger.
- Automatic announcement system and Emergency and Panic button inside the car
- Priority seats are provided to old aged person, person with disability, pregnant women's and Separate women coach in Delhi Metro ensuring safety of women.
- Operating time period varies 19 to 20 hr as per circumstances.
- Connects various economic, social and administrative areas and Night tube facility in London underground.
- Travel cards, QR based ticket, contactless payment facility and PIB- passenger information board inbuilt inside the car.

Review of literature

Cities in India occupy a central position for propelling India's economic growth. This is highlighted by the fact that cities in India just occupy 3% of the nation's land, but their contribution to GDP is around 60%. However, this economic dynamism is primarily limited to India's large cities, such as Bengaluru, Delhi, Chennai, Mumbai, Kolkata, Hyderabad and Pune. Many other cities are not meeting their potential in serving as engine of economic growth and job creation.

Factors which are responsible:- Inadequate investment in Urban Infrastructure, Fragmentation of responsibilities and limited ownership of economic initiatives between urban local bodies and State government agencies, Lack of business and investment- friendly urban areas. (ADB, 2022).

Transportation is a critical sector in India's fast-growing economy, with increasing demand for robust infrastructure and efficient services. Reliable urban transport systems are essential for sustaining high economic growth, as rising urban mobility makes accessing jobs, services, and activities more challenging in terms of time, cost, and convenience. Baidur (2011) ^[6] also focuses on Sustainable planning of Urban Transport System by taking a Case Study of Bengaluru Metropolitan Region. Rapid urbanization, motorization, and a shrinking share of non-motorized transport options drive trends in urban mobility, leading to issues like poor road conditions, parking scarcity, air pollution, and declining road safety. Research highlights gaps in India's transport laws, unregulated land markets,

fragmented institutions, and transport layouts as key challenges. Addressing these requires strong government and local authority accountability in planning and decision-making (IIHS, Report, 2021-12, <https://doi.org/10.24943/9789387315167>).

Transport for London (TfL), which oversees the capital's transport network, highlighted its sustainability strategy in a 2016 report based on three pillars: society, environment, and economy. Social sustainability demonstrates the broader social value of TfL's services beyond mere economic returns, as it improves the lives of Londoners and creates thriving communities. TfL's financial sustainability is linked to capital investments aimed at green recovery and accounting for environmental costs. Public transport plays a vital role in supporting this, bringing 1.2 million people into the CAZ every weekday before the pandemic. The CAZ is key to driving jobs and growth for both London and the wider UK economy (TfL, 2016).

According to Murty and his team, the rising demand for public transport in megacities significantly impacts the urban ecosystem, particularly through increased atmospheric pollution and changes in land-use patterns. To mitigate these effects, an ecologically sustainable urban transport system can be achieved by adopting a balanced mix of alternative transportation modes that are environmentally friendly and promote optimal land-use patterns. There are two notable initiatives—the introduction of Compressed Natural Gas (CNG) in certain vehicles and the expansion of the metro rail system—have contributed to a marked reduction in atmospheric pollution. The Delhi Metro offers multiple benefits, including a decrease in air pollution, time savings for passengers, fewer accidents, reduced traffic congestion, and significant fuel savings. The financial rate of return on the investments in the Metro has been estimated at 17%, while the economic rate of return is higher, at 24%. Furthermore, accounting for the benefits from the reduction of urban air pollution due to the metro has boosted the economic rate of return by an additional 1.4%. This underscores the broader socio-economic and environmental advantages of investing in sustainable public transport infrastructure like the Delhi Metro. It not only improves urban living conditions but also delivers strong economic returns by mitigating environmental damage (Murty *et al.*, 2006)^[3].

The significance of transport as a key driver of socio-economic growth has increased alongside the evolution of society and the expansion of global relations driven by the globalization process. Transport infrastructure, particularly roads, plays a vital role in supporting these activities. Different road conditions can significantly impact logistics operations, leading to delays or even making certain areas inaccessible. To ensure the smooth functioning of economic activities, the expansion and maintenance of road networks are essential. Effective transport infrastructure thus underpins the flow of commerce, enhancing economic performance and contributing to overall growth (Ejiogu *et al.* 2020)^[4].

Research gap

After analyzing numerous research studies, the majority of these studies have focused on comparing the London Underground with rail transit systems in other countries. As a result, there is limited research that directly compares it with the rail systems in India. This gap in literature makes it

challenging to draw direct comparisons between London's underground network and India's railway infrastructure. Due to need and future of rapid rail especially in India, more studies were requiring. Therefore, we are try to make needed bridge this research gap and provide deeper insights and in this present work focusing on India's transit systems with relation to the London Underground.

Objectives

My objective is to compare the Delhi Metro with the world's first urban rail network, the London Underground. The second objective is to highlight why the Delhi Metro is one of the top facilities in the world, providing a safe and efficient journey through the Regional Rapid Transit System (RRTS). The third objective is to explore how the government should approach urban rail transit development in other cities, ensuring sustainable and efficient public transportation systems. This study aims to analyze best practices and provide insights for improving metro networks in emerging urban centers.

Research methodology

Present study based on secondary data sources, secondary data is used to evaluate the financial performance of the Rapid Rail Transit system in both London and Delhi. This data is collected from the respective transport authorities, namely Transport for London and Delhi Metro Rail Corporation. For evaluating short term financial performance of an organisation over the year Gross Revenue and Expenses, with Operational Revenue and Expenses also with Operating profit variable is used. For the efficiency of financial output percentage of Earning before Income Tax, Depreciation and Amortization over Gross revenue is used.

Data analysis

In Table 1 The analysis of gross revenue and expenses for Transport for London (TfL) and Delhi Metro Rail Corporation (DMRC) from 2002-03 to 2021-22 highlights significant differences in financial performance and growth. TfL's revenue increased from \$2965.65 million in 2002-03 to \$8804.07 million in 2019-20 but saw a sharp decline to \$3660.54 million in 2020-21 due to the pandemic. In contrast, DMRC's revenue grew from \$0.88 billion in 2002-03 to \$1050.10 billion in 2019-20, showing rapid expansion. However, TfL consistently operated at a deficit, with expenses exceeding revenue throughout the period, increasing from \$4855.82 million in 2002-03 to \$11872.85 million in 2021-22. Meanwhile, DMRC maintained better cost efficiency, keeping its expenses lower in comparison, rising from \$0.87 billion to \$764.67 billion in the same period.

The impact of COVID-19 was significant for both systems, with revenue dropping by nearly 58% for TfL and 50% for DMRC, though DMRC showed a more stable financial recovery. Overall, DMRC has demonstrated faster growth, cost efficiency, and a better balance between revenue and expenses, making it a strong urban rail model, while TfL relies more on external funding and faces greater financial strain. Table 2 The financial comparison between London Underground and Delhi Metro from 2002-03 to 2021-22 in terms of Operating Expenses and Operating Income highlights key differences in their economic efficiency and growth.

Table 1: Gross Revenue and Gross Expenditure of TFL and DMRC (In Million \$)

Year	Gross Revenue		Gross Expenses	
	TFLgr	DMRCgr	TFLge	DMRCge
2002-03	2965.65	0.88	4855.82	0.87
2003-04	3545.95	6.98	6015.65	4.79
2004-05	3903.02	10.82	6401.75	7.82
2005-06	4182.78	67.21	6774.40	15.33
2006-07	4531.14	81.25	7514.21	21.57
2007-08	5009.68	75.50	7899.70	31.56
2008-09	4967.97	108.35	8694.97	39.37
2009-10	5401.43	110.46	8855.71	57.08
2010-11	5925.81	240.71	7982.21	125.79
2011-12	6329.33	336.49	8198.56	196.77
2012-13	6751.79	402.32	8713.61	248.45
2013-14	7318.03	478.71	10349.69	319.71
2014-15	7699.39	534.57	10779.18	348.96
2015-16	8080.45	651.92	11361.77	460.04
2016-17	8249.44	806.57	11052.68	592.04
2017-18	8223.77	929.79	11476.82	654.99
2018-19	8642.11	967.25	11552.30	673.47
2019-20	8804.07	1050.10	11824.11	719.49
2020-21	3660.54	492.39	11313.79	596.55
2021-22	6590.44	700.15	11872.85	764.67

Sources: Annual report of DMRC and TFL, (TFL=Transport for London, DMRC= Delhi Metro Rail Corporation)

London Underground's operating expenses have consistently been high, rising from \$2636.54 million in 2002-03 to \$4148.25 million in 2021-22, while Delhi Metro's expenses started at a significantly lower \$0.20 million in 2002-03 and increased gradually to \$435.52 million in 2021-22. Meanwhile, operating income for London Underground rose from \$1882.37 million in 2002-03 to a peak of \$4496.61 million in 2018-19, before declining due to the pandemic. In contrast, Delhi Metro's operating income grew impressively from \$0.64 million in

2002-03 to \$890.86 million in 2019-20, reflecting its rapid expansion and increasing ridership.

Table 2: Operating Revenue and Operating Expenses (In Million \$)

Year	Operating Expenses		Operating Income	
	London Underground	Delhi Metro	London Underground	Delhi Metro
2002-03	2636.54	0.20	1882.37	0.64
2003-04	2958.01	1.39	1967.94	5.50
2004-05	3005.38	2.28	2085.58	8.01
2005-06	3222.34	5.70	2169.62	16.96
2006-07	3298.74	8.31	2418.67	33.33
2007-08	3376.66	9.74	2624.93	47.46
2008-09	3657.79	12.41	2800.64	58.81
2009-10	3789.19	27.79	2866.34	78.92
2010-11	3094.00	76.16	2965.65	216.00
2011-12	3260.54	120.66	3329.29	291.53
2012-13	3451.53	177.84	3538.62	362.49
2013-14	3781.55	237.66	3806.00	441.92
2014-15	3916.01	237.19	4026.02	452.96
2015-16	4126.86	329.29	4174.22	571.68
2016-17	3867.11	448.95	4132.97	713.97
2017-18	3929.76	437.40	4207.84	820.75
2018-19	4267.42	430.08	4496.61	852.41
2019-20	4126.86	440.73	4444.66	890.86
2020-21	4048.94	316.73	1089.39	374.59
2021-22	4148.25	435.52	2547.01	618.85

Sources: Annual Report of TFL and DMRC

The impact of COVID-19 was significant for both systems, causing a steep decline in operating income in 2020-21, with London Underground's income dropping to \$1089.39 million and Delhi Metro's to \$374.59 million (Figure 1). However, in 2021-22, Delhi Metro recovered faster, with income reaching \$618.85 million, whereas London Underground's recovery was slower, reaching only \$2547.01 million.

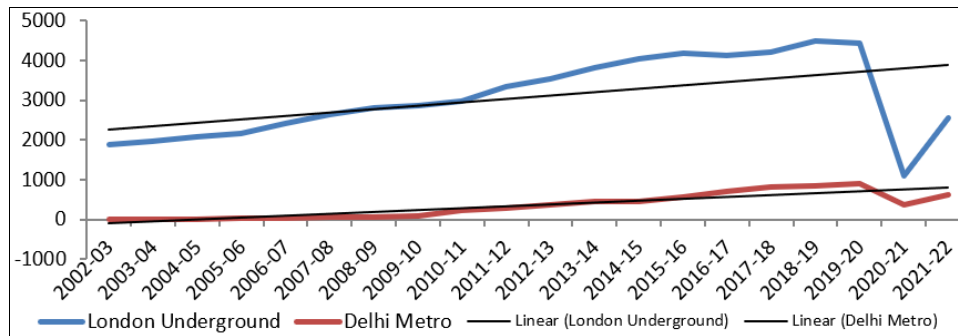


Fig 1: Comparison of Operating Revenue: London Underground and Delhi Metro
Source: Construction by Authors

Table 3: Operating Profit-Loss of London Underground and Delhi Metro (In Million \$)

Year	London Underground	Delhi Metro
2002-03	-754.17	0.44
2003-04	-990.08	4.11
2004-05	-919.80	5.73
2005-06	-1052.72	11.26
2006-07	-880.07	25.02
2007-08	-751.73	37.72
2008-09	-857.15	46.40
2009-10	-922.85	51.14
2010-11	-128.34	139.84
2011-12	68.76	170.87
2012-13	87.09	184.65

2013-14	24.45	204.26
2014-15	110.01	215.77
2015-16	47.36	242.39
2016-17	265.85	265.01
2017-18	278.08	383.35
2018-19	229.18	422.33
2019-20	317.80	450.14
2020-21	-2959.54	57.86
2021-22	-1601.24	183.33

Source: Compiled by Author from various reports of TFL and DMRC.

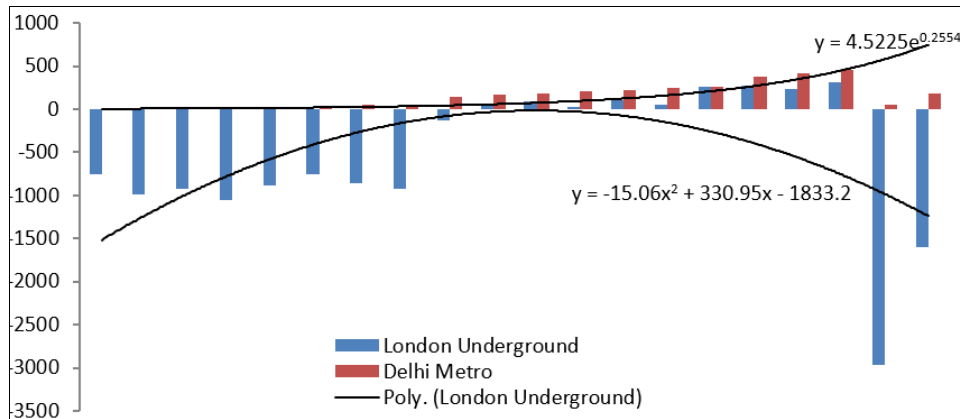


Fig 2: Operating Profit and Loss of London Underground and Delhi Metro

Source: Construction by Authors

London Underground shows a quadratic trend, $y = -15.06x^2 + 330.9x - 1833$ and this highlighted that losses initially decreased, then stabilized, and later increased again and London Underground has incurred significant losses in operating over time. Delhi Metro shows a exponential trend line follows the equation, $y = 4.522e^{0.25x}$ and This indicates that Delhi Metro's operating profits have been increasing exponentially over time, highlighted positive financial growth (Figure 2).

In table 3 the operating profit/loss analysis of London Underground and Delhi Metro from 2002-03 to 2021-22 reveals key insights into their financial performance. London Underground consistently operated at a loss from 2002-03 to 2009-10, with deficits reaching -\$1052.72 million in 2005-06. However, from 2010-11, it briefly turned profitable, peaking at \$317.80 million in 2019-20. The COVID-19 pandemic severely impacted its finances, causing massive losses of -\$2959.54 million in 2020-21 and -\$1601.24 million in 2021-22, highlighting its reliance on high ridership and government support. In contrast, Delhi Metro has consistently operated at a profit since inception. It started with a small profit of \$0.44 million in 2002-03, and steadily increased, surpassing \$100 million in 2010-11 and \$200 million in 2013-14. By 2019-20, it reached \$450.14 million, reflecting its strong financial management and growing ridership. Even during the pandemic, Delhi Metro remained profitable with \$57.86 million in 2020-21, recovering to \$183.33 million in 2021-22.

Earnings before Interest, Tax, Depreciation and Amortization

In table 4 shows Earnings before Interest, Tax, Depreciation and Amortization (EBITDA) as percent of Gross Revenue from 2009-10 to 2021-22, highlights significant differences in financial efficiency between Transport for London (TFL) and Delhi Metro (DMRC). DMRC (Delhi Metro) started with a very high EBITDA (~48.23%) in 2009-10, indicating strong profitability. Over time, DMRC's EBITDA has been consistently declining, dropping to -9.22% by 2021-22. In contrast, TFL started with a negative EBITDA (~-6.25%) in 2009-10, indicating financial difficulties. TFL's EBITDA showed an improving trend, reaching a peak of 20.6% in 2013-14, but later fluctuated. By 2021-22, TFL's EBITDA (22.8%) surpassed DMRC's (-9.22%), marking a significant financial shift (Figure 3).

Table 4: EBITDA* as % of Gross Revenue TFL and DMRC

Year	TFL	DMRC
2009-10	-6.25	48.23
2010-11	4.55	46.67
2011-12	12.1	41.52
2012-13	17.77	38.25
2013-14	20.6	33.21
2014-15	16.7	34.72
2015-16	8.8	29.43
2016-17	11.16	26.6
2017-18	20.5	29.56
2018-19	15.7	30.38
2019-20	18.4	32.48
2020-21	13.9	-21.15
2021-22	22.8	-9.22

Source: Annual report of DMRC, Fitch Report,

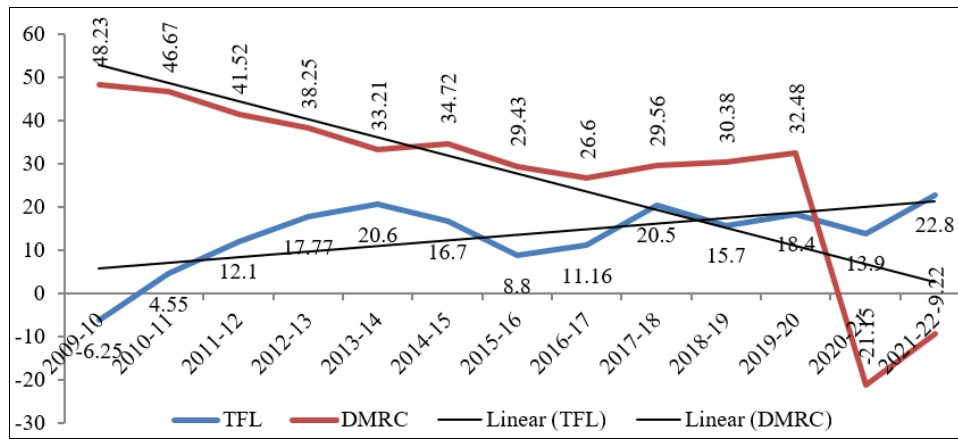


Fig 3: Comparison EBITDA* as % of Gross Revenue of TFL and DMRC
Source: Construction by Authors

DMRC's Linear Trend Line has Negative Slope indicates a steady decline in profitability over time. Suggests rising operational costs, reduced efficiency, or financial strain. The sharp fall in 2020-21 and 2021-22 may be due to COVID-19-related losses (lockdowns, reduced ridership, increased expenses (Figure)). While, TFL's Linear Trend Line has Positive Slope shows gradual financial improvement over time. Despite fluctuations, TFL managed to turn around from losses to a stable EBITDA. Indicates better cost management, revenue optimization, or government support. The table 5 compares the operational track length of the Delhi Metro and the London Underground from 2002-03 to 2021-22. Delhi Metro started with 13.28 km in 2002-03 and expanded significantly to 360.98 km by 2021-22. Its most rapid growth occurred between 2008-09 and 2018-19, particularly in 2009-10 (increasing by nearly 65 km) and 2017-18 (by 39.49 km). Meanwhile, the London Underground, which already had an extensive network of 434 km in 2002-03, saw relatively modest growth, reaching 505 km in 2017-18 and remaining constant thereafter. The Delhi Metro's expansion reflects its role in addressing urban mobility challenges in a rapidly growing city. In contrast, London's growth was limited, as it already had an extensive network.

Table 5: Track Length of London Underground and Delhi Metro (in km.)

Year	Delhi Metro	London Underground
2002-03	13.28	434
2003-04	25.65	434
2004-05	55.93	434
2005-06	65.23	438
2006-07	65.23	438
2007-08	68.36	438
2008-09	90.97	458
2009-10	155.68	458
2010-11	167.10	458
2011-12	167.10	458
2012-13	167.10	470
2013-14	188.05	470
2014-15	191.12	470
2015-16	209.97	470
2016-17	209.97	470
2017-18	249.46	505
2018-19	342.07	505
2019-20	359.23	505
2020-21	359.23	505
2021-22	360.98	505

Source: Annual report of TFL and DMRC

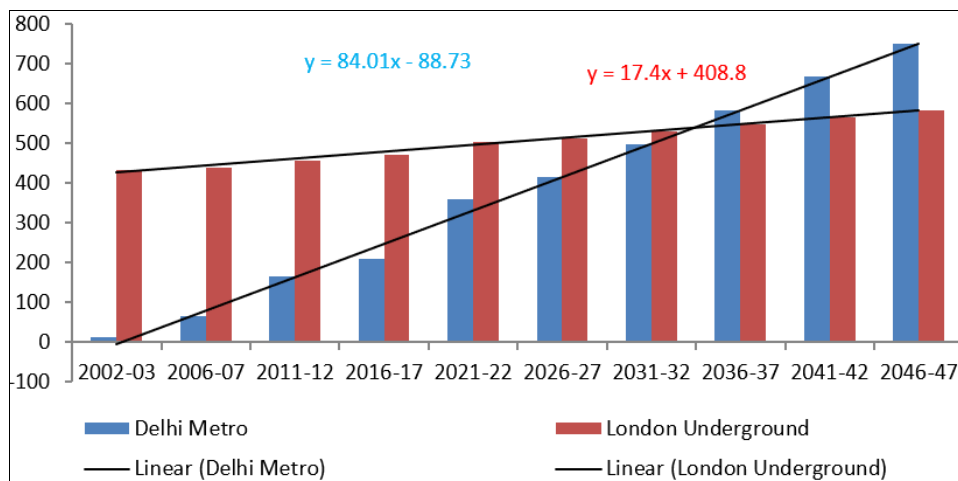


Fig 4: Track Length and Forecast of London Underground and Delhi (in km.)

Source: Construction by Authors

In 2002-03, the London Underground already had a significantly higher track length than the Delhi Metro.

Although, this year was beginning year of Delhi Metro. The Delhi Metro's track length has been increasing steadily, with

a sharper growth trend compared to London Underground. The London Underground's track length shows only a modest increase over the years. Around 2031-32, Delhi Metro's track length is projected to surpass that of the London Underground. By 2046-47, Delhi Metro is expected to have a much longer network than the London Underground (Figure 4). The slope indicates fast-paced growth, aligning with Delhi Metro's continuous expansion projects. The London Underground's expansion is relatively stagnant, reflecting its status as an already well-established network.

Findings and Conclusion

- Overall, DMRC has demonstrated faster growth, cost efficiency, and a better balance between revenue and expenses, making it a strong urban rail model, while TfL relies more on external funding and faces greater financial strain.
- Overall, Delhi Metro demonstrates a more efficient financial model with controlled operating expenses and steady income growth, whereas London Underground faces higher operational costs, impacting its profitability and financial sustainability.
- DMRC's lower operational costs and self-sustainability make it a more efficient urban transit model than London Underground.
- DMRC demonstrated stronger financial efficiency in normal conditions but proved more vulnerable to ridership shocks, whereas TfL, despite its past inefficiencies, showed resilience during crises.
- While London Underground remains one of the largest and oldest metro systems, its expansion is relatively stagnant, mainly due to land constraints and an already extensive network. On the other hand, Delhi Metro's aggressive expansion reflects India's commitment to urban mobility and sustainable transportation, catering to rapid urbanization and increasing ridership demand. Moving forward, Delhi Metro's continued expansion could make it one of the largest metro networks, while London Underground must focus on modernization and service efficiency rather than expansion.

DMRC should focus on diversifying revenue sources such as commercial real estate and advertisements to reduce reliance on ticket fares, while TfL needs to enhance cost control measures for sustainable profitability. London Underground is struggling with increasing losses in recent years. Delhi Metro, on the other hand, is showing an upward trend in profitability. If trends continue, Delhi Metro is on a path to financial sustainability, while London Underground's losses might worsen. Despite differences in economic structures, both systems face challenges such as high capital expenditures and fluctuating ridership trends. The comparative analysis offers insights into best practices, policy implications, and potential strategies for improving financial resilience in rapid rail transit.

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