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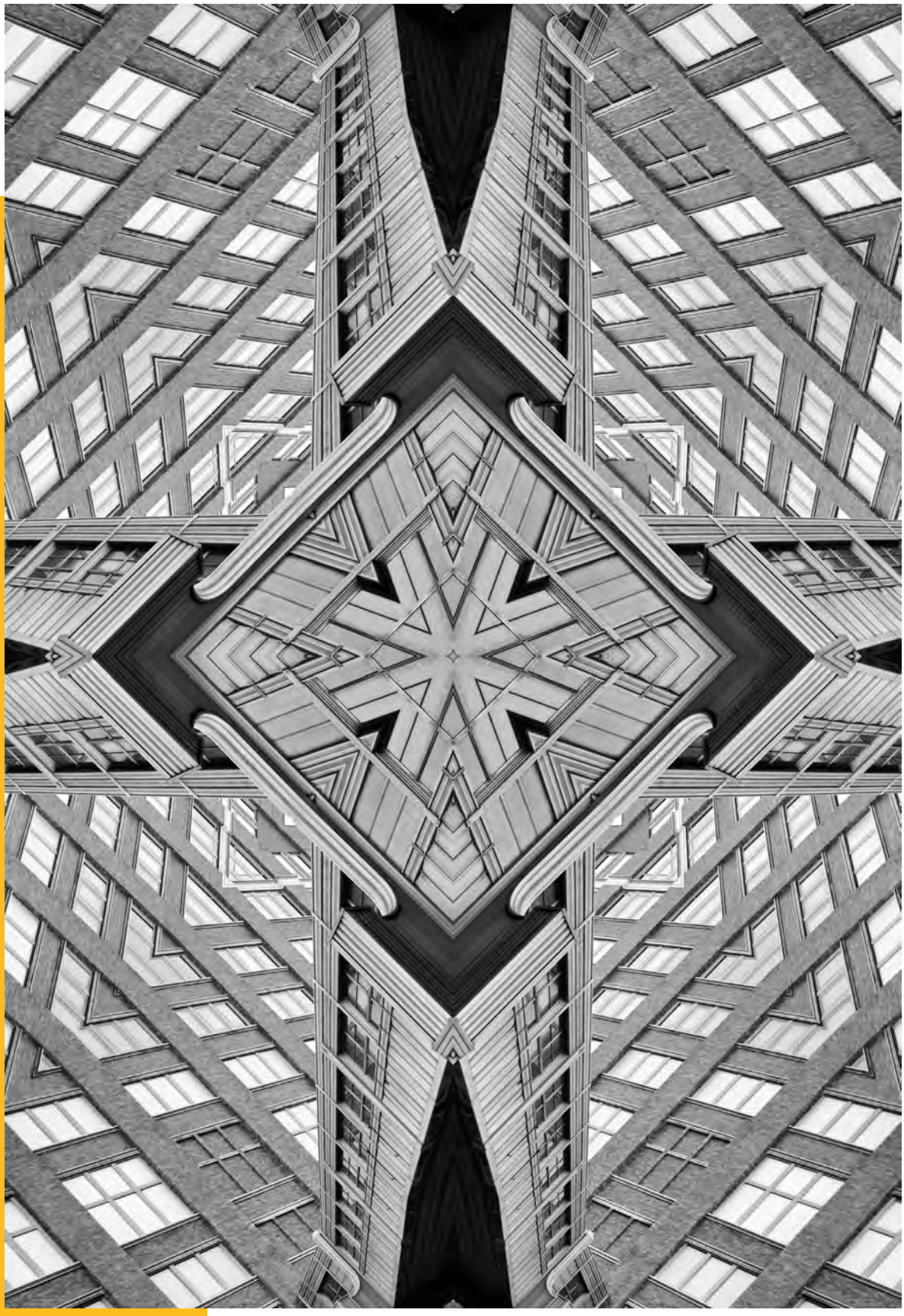

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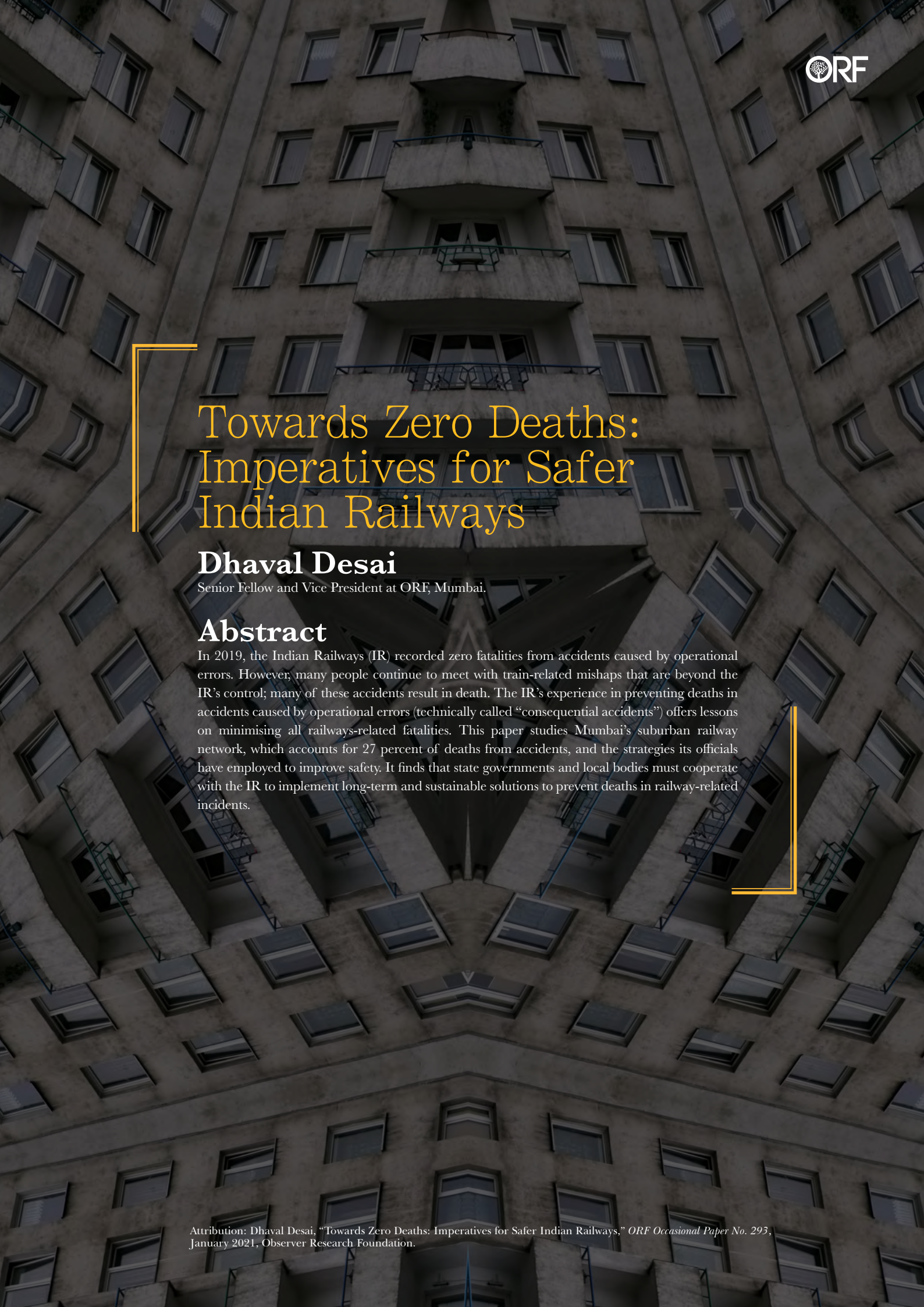

Towards Zero Deaths: Imperatives for Safer Indian Railways

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Abstract

In 2019, the Indian Railways (IR) recorded zero fatalities from accidents caused by operational errors. However, many people continue to meet with train-related mishaps that are beyond the IR's control; many of these accidents result in death. The IR's experience in preventing deaths in accidents caused by operational errors (technically called "consequential accidents") offers lessons on minimising all railways-related fatalities. This paper studies Mumbai's suburban railway network, which accounts for 27 percent of deaths from accidents, and the strategies its officials have employed to improve safety. It finds that state governments and local bodies must cooperate with the IR to implement long-term and sustainable solutions to prevent deaths in railway-related incidents.

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Introduction

In 2019-2020, the Indian Railways (IR) recorded zero fatalities due to "consequential accidents"—incidents caused by operational lapses, such as derailments, collisions and fires.[1] However, since 2017, about 10,000 people have lost their lives each year in other railway-related "untoward incidents" that happen due to factors which, according to the IR, are beyond its control.[2] These accidents include people falling off the tracks or trespassers being knocked down by running trains or hit by poles while hanging off overcrowded trains. The government think tank NITI Aayog has questioned the IR's claims of "zero deaths", given the high death rate due to untoward incidents—explicitly referring to Mumbai's suburban railway services. It urged IR officials to include such incidents in its purview.[3]

The Ministry of Railways' High-Level Safety Review Committee (HLSRC) raised a similar concern in February 2012. The HLSRC had referred to the casualties on Mumbai's suburban railway services as a "massacre which no civilised society can accept," and stressed that the "reluctance of Indian Railways to own these casualties, which do not fall under the purview of train accidents but are nevertheless accidents on account of trains can by no means be ignored."[4]

> "Since 2017, 10,000 people in India have lost their lives each year in railway-related accidents."

Although the Railway Board reiterated to the NITI Aayog that no deaths were recorded in 2019-20 in "consequential" accidents, it acknowledged that up to 30,000 people have died in "untoward incidents" in the past three years[5] and said that such fatal mishaps "happened primarily due to negligence or carelessness on the part of the passengers/public."[6] Given the IR's stance, these numbers remain cold data in the death registers of the Government Railway Police (GRP) and Railway Protection Force, and there is little effort to prevent the occurrence of such events.

Enhancing Railway Safety: Towards Zero Deaths

The IR defines consequential accidents as "train accidents having serious repercussion in terms of loss of human life, human injury, loss to railway property or interruption to rail traffic" over the specified thresholds (for losses to railway property and traffic interruptions).[7] Consequential accidents are categorised as: derailments; manned and unmanned level crossing accidents; collisions; fire/explosion-related accidents; and miscellaneous/others, including accidents caused by natural elements.[8]

Between 2010-11 and 2019-20, derailments (55 percent) and level crossing-related mishaps (36 percent) accounted for over 90 percent[11] of all fatalities caused by consequential accidents (see Table 1).[12]

Over the 2010-17 period, for which all-India data on deaths caused in consequential accidents is available, being run over by speeding trains at manned and unmanned level crossings led to the highest number of fatalities (863) among the 1711 deaths recorded (see Table 2).[13]

> "The railway ministry has pledged to eliminate all operational accidents by 2020."

Between 2012-13 and 2016-17, 1,634 people were injured in consequential accidents, with about 57 percent of injuries caused by train derailments (see Table 3).[15]

Given the high number of fatalities and injuries due to operational lapses, it was imperative for the IR to accord top priority to reducing and preventing consequential accidents.

Although the Special Railway Safety Fund was established in 2001 as a non-lapsable fund to wipe out the arrears in pending safety enhancement works,[17] the big push towards reducing the number of accidents came in December 2009 with the introduction of the railway ministry's Vision 2020 document that pledged to eliminate all consequential accidents by 2020.[18] In 2011, the ministry constituted the HLSRC to examine all technical and technology-related aspects to ensure accident-free train operations. In its report submitted in 2012, the HLSRC suggested a slew of safety enhancement measures, seeking an investment of INR 1 trillion.[19] An expert committee constituted by the railway ministry in 2011 to prepare a roadmap for the modernisation of IR operations estimated investment of INR 400 billion to enhance operational safety.[20] However, the IR faced severe funding constraints in adopting both committees' recommendations.

Table 1: Consequential accidents by category (2010-2020)

Description	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Total
Derailments	80	55	49	53	63	65	78	53	46	29	571
Manned level crossing	5	7	5	4	6	6	0	13	6	1	354
Unmanned level crossing	48	54	53	47	50	29	20				
Collisions	5	9	6	4	5	3	5	3	0	3	43
Fire	2	4	9	7	6	0	1	3	6	7	45
Others	1	2	0	3	5	4	0	0	1	1	17
Total	141	131	122	118	135	107	104	72	59	41	1030

Source: NITI Aayog[9] and Press Information Bureau[10]

Table 2:
Deaths caused by consequential accidents by category (2010-17)

Description	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Total
Derailments	4	73	5	6	104	36	196	424
Manned LC	7	6	18	6	31	12	0	80
Unmanned LC	130	204	123	98	130	58	40	783
Collisions	240	22	27	1	15	1	5	311
Fire	0	9	31	35	0	0	0	75
Others	0	5	0	6	12	15	0	38
Total casualties	381	319	204	152	292	122	241	1711

Source: NITI Aayog[14]

Table 3:
Injuries caused by consequential accidents by category (2012-17)

Description	2012-13	2013-14	2014-15	2015-16	2016-17	Total
Derailments	159	93	265	100	327	944
Manned LC	25	2	21	10	0	58
Unmanned LC	81	116	85	41	19	342
Collisions	76	7	58	12	28	181
Fire	40	6	0	0	0	46
Others	0	10	28	25	0	63
Total injuries	381	234	457	188	374	1634

Source: NITI Aayog[16]

The 12th report of the Parliamentary Standing Committee on Railways, presented to both houses of parliament in December 2016, reiterated the intent to prioritise railway safety and tackle it "promptly, precisely and diligently".[21] The standing committee recommended a separate department to oversee railway safety, as "inter-disciplinary methods of dealing with this aspect at micro-level only serves to reduce its efficiency, resulting in delayed response and compromises on safety".[22] Subsequently, an internal railway ministry panel recommended an investment of INR 1.54 trillion for safety enhancements,[23] INR 1.19 trillion of which was to be raised through the Rashtriya Rail Sanraksha Kosh (RSSK), a separate national corpus, and the rest to be contributed by the IR. The RRSK was established in 2017 with an initial corpus of INR 1 trillion for five years, with an annual allocation of INR 200 billion.[24]

NITI Aayog prepared a fund allocation roadmap for the RRSK[25] based on a comprehensive assessment of consequential accident data and department-wise responsibility. Funding to IR directorates and functions found accountable for derailments and level crossing accidents was prioritised.

The IR follows an established process for cause analysis (to identify and fix responsibility) and to determine system deficiencies after a consequential accident. The directorate-wise responsibilities[26] are categorised as:[27]

1. Failure of railway staff: Accidents caused by lapses by railway personnel

2. Failure other than railway staff (FORS): Involving trespassing and level crossing accidents

3. Failure of equipment

    a. Rolling stock: related to the Mechanical Directorate (for instance, locomotives, coaches/wagons and wheels)

    b. Track: generally associated with lapses of the Engineering Directorate (for example, rail fractures)

    c. Electrical: usually involving the Electrical Directorate (for instance, failure of overhead equipment, electrical multiple units, or EMUs, and e-locomotives)

    d. Signalling and telecommunications: Related with IR's Signalling and Telecommunications Directorate (for instance, signalling and communications systems failure)

4. Traffic and Commercial: All accidents related to lapses, such as defective loading and unloading, and train operations with improper route setting and securing

5. Incidental: Accidents on account of natural or human-made factors, such as landslides, floods, earthquake or sabotage.

The FORS (44 percent) and the Electrical Directorate (27 percent) had the highest responsibility share of the 586 accidents recorded between 2012-13 and 2016-17 (see Figure 1).[28]

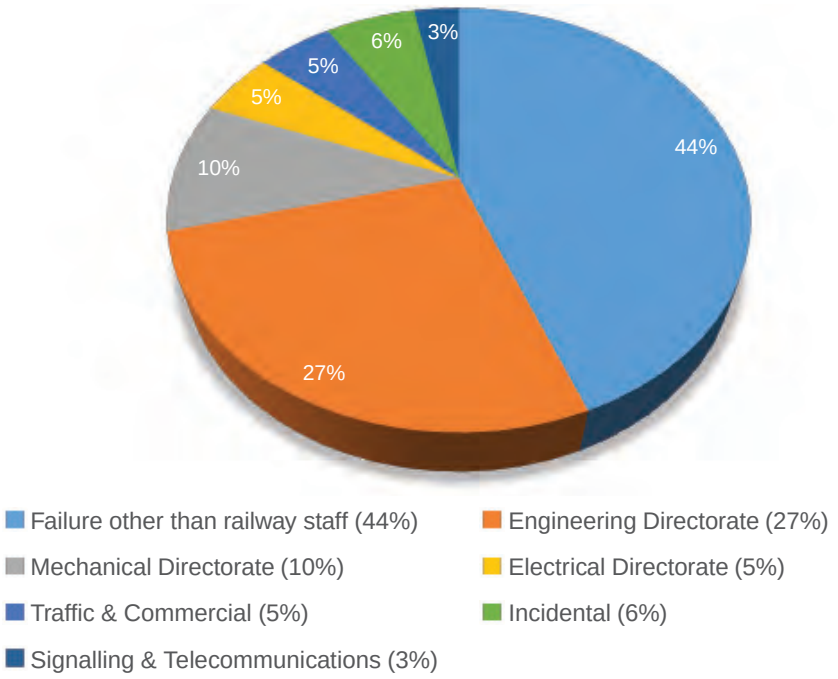
NITI Aayog found human failure, including the fault of railway staff, to have caused 87 percent of the 586 consequential accidents recorded between 2012-13 and 2016-17. Year-on-year, the share of fault of railway staff in accidents grew incrementally.[30]

Safety-related priority projects were identified based on this responsibility matrix. For the 2017-19 period, RRSK funds (INR 400 billion) have been allocated as per the finance ministry's 'Guidelines for Operating Rashtriya Rail Sanraksha Kosh',[31] with the IR utilising INR 340.91 billion for priority works aimed at strengthening and upgrading traffic facilities, rolling stock, tracks, signal and telecommunication networks, and constructing road over/under bridges at level crossings.[32] The utilisation of funds is periodically reviewed by an RRSK monitoring committee chaired by the NITI Aayog CEO, and annually by the Cabinet Committee on Economic Affairs headed by the Prime Minister.[33]

The IR has made targeted interventions to reduce fatalities caused by derailments and level crossing accidents, and to address lapses by railway staff through skills enhancement. Over 300,000 non-gazetted officers across the country have been trained through a refresher course,[34,35] and the IR has eliminated all unmanned level crossings across its broad gauge and has removed 6,145 manned and unmanned level crossings on its other route classifications.[36,37,38] Many of the conventional coaches manufactured by the Integral Coaches Factory have been

> "Human failure caused 87 percent of the 586 consequential accidents recorded between 2012-13 and 2016-17."

Figure 1: Directorate-wise responsibility for consequential accidents (2012-13 to 2016-17)



Source: NITI Aayog[29]

replaced with the technologically-superior Linke Hofmann Busch coaches, which offer better safety, stability and speed (1,469 coaches were introduced in 2016-17, 2,480 in 2017-18 and 4,429 in 2018-19).[39]

Additionally, the RRSK funds have been utilised for anti-collision systems, centralised traffic control, train management systems, signalling, bridge inspection and management, increased night-time footplate inspection, and public engagement through safety awareness campaigns.[40]

Improved cooperation between the IR's departments and coordination between the IR and state governments and local bodies has resulted in a decline in casualties at level crossings. Fatalities due to vehicles or people being run over by trains at level crossings have declined, from 3,347 in 2010[41] to 1,762 in 2019[42] (see Table 4). However, the decline has been inconsistent and still constitutes about 7 percent of all railway-related accidental deaths.

According to National Crime Records Bureau (NCRB) data on accidental deaths between 2010 and 2019, 252,655 lives were lost to 'railway accidents' other than those at level crossings, such as people falling from overcrowded trains; being hit by poles while hanging out of overcrowded trains; falling in gaps between the railway coach footboard and the platform; and trespassing on tracks within the railway station areas, at level crossings and on mid-sections (tracks in between two stations) along the rail network (see Table 4).

According to NCRB data, in 2019, the death toll from train-related accidents was 70 per day, a figure nearly six times higher than the Railway Board's assessment of up to 10,000 deaths per year.[53] The NCRB data does not differentiate between people committing suicide by coming under running trains and road vehicles. Of the 6,68,157 suicides recorded by the NCRB across India between 2015 and 2019, 2.52 percent (17,223) were by people coming under running trains and road vehicles. The IR cannot be held responsible for suicidal deaths, and so the NCRB must seek bifurcated data from the states for a more precise analysis of railway-related deaths due to untoward incidents.

"Improved cooperation between the IR's departments and coordination between the IR and state governments and local bodies has resulted in a decline in casualties."

Table 4:
Deaths by railway-related accidents (2010-19)

Year	Level crossing deaths	Other railway accidental deaths	Total	% of level crossing deaths of total railway mishaps
2010[43]	3,347	24,451	27,798	12.04
2011[44]	2,366	25,872	28,238	8.38
2012[45]	1,808	27,402	29,210	6.19
2013 [46]	1,318	27,765	29,083	4.53
2014[47]	2,575	25,006	27,581	9.33
2015[48]	2,650	26,066	28,716	9.22
2016[49]	3,133	22,970	26,103	12
2017[50]	1,534	23,959	25,493	6.01
2018[51]	1,507	24,545	26,052	5.78
2019[52]	1,762	24,619	26,381	6.67
Total	22,000	252,655	274,655	8.01

Source: Compiled by the author from NCRB's 'Accidental Deaths and Suicides in India' reports of respective years.

Enhancing Railway Safety: Towards Zero Deaths

According to NCRB data, 166,533 railway accidents were reported across India between 2014 and 2019; over 71 percent of these mishaps involved instances of people falling off running trains or trains running over people on the tracks (see Table 5).

Fatalities from trespassing continue to remain high along the mid-sections. The absence of foot overbridges or subways for safe passage across railway tracks has meant that people have no alternative but to trespass on the tracks to cross over. The Mumbai metropolitan region (MMR), which is served by the suburban services of the Western Railway (WR) and Central Railway (CR) zones of the IR, illustrates how the lack of appropriate infrastructure (foot overbridges) results in avoidable casualties from trespassing.

The Mumbai suburban railway system (MSRS) ferries nearly eight million commuters daily,[60] or about 2.92 billion commuters annually. Covering 413 route kilometres,[61] the MSRS constitutes a minuscule 0.6 percent of the IR's national network, which, spread over 68,443 route kilometres,[62] is the world's third largest railway system.[63] The MSRS comprises 65.61 percent of the total annual ridership of 4.45 billion logged by the IR's suburban services.[64]

Of the approximate 30,000 deaths over the last three years that have been acknowledged by the Railway Board as being caused by 'untoward incidents,' over 27 percent occur on the MSRS. Given that the MSRS records nearly one-third of the countrywide deaths due to 'untoward incidents' despite being only a fraction of the national railway network, it is a true reflection of the problem's magnitude.

> "7 of every 10 of all railway mishaps from 2014 to 2019 involved people falling off running trains or trains running over people on the tracks."

Table 5: 'Untoward' railway accidents (2014-19)

Year	Railway Accidents	Falling from trains and getting run over by trains	% of total railway accidents
2014[54]	28,360	17,480	61.6
2015[55]	29,419	21,339	72.5
2016[56]	25,927	19,160	73.9
2017[57]	27,197	19,370	71.2
2018[58]	27,643	18,894	68.4
2019[59]	27,987	21,361	76.3
Total	166,533	117,604	70.5

Source: Compiled by the author from NCRB's 'Accidental Deaths and Suicides in India' reports of respective years.

Case Study: Mumbai Suburban Railway System

Cumulative data on deaths on the MSRS between 2010 and 2019 shows that, on average, nine people have died each day in railway-related mishaps (see Table 6). On average, there have been 3,280 deaths per year, but the year-on-year loss of life has declined since 2012.

The CR and WR have made several interventions for capacity and safety enhancements under the Mumbai Urban Transport Project (MUTP) since 2002, which has led to a decline in fatality numbers. But even in 2019, when the IR achieved its target of zero deaths from consequential accidents, the MSRS recorded over seven deaths per day (see Table 6). Assuming the pace and scale of such interventions remain the same as in the past, applying the arithmetic progression formula suggests that minimising the death count to only extreme factors such as suicides, natural disasters and sabotage will take over 40 years (see Figure 2).

Although the number of fatalities has declined, the causes of deaths on the MSRS have essentially remained constant (see Figure 3).

Furthermore, these fatality numbers do not include the railway officials, gangmen and police personnel who die while on duty. According to joint CR and WR data, between 2009 and 2013, 139 track maintainers or gangmen died on the MSRS,[67] rising to 150 by February 2016.[68]

Train accidents caused by 'untoward incidents' cause grievous injuries to a larger number of people. According to GRP data, between 2013 and 2018, more than 20,000 people were injured on the MSRS.[69] While fatalities have declined marginally over the past decade, injury numbers have remained somewhat constant, with an average of 3,337 injuries caused between 2013 and 2018 (see Table 7).[70]

Most people who fall off high-speed trains or are knocked down by a fully loaded freight/passenger/EMU rake suffer severe injuries and may be maimed for life. There is a high societal, economic and opportunity cost for each life lost and every injury. If the number of victims who succumb to injuries after admission in hospitals is tallied, the death toll from train accidents will rise considerably. But these numbers remain documented as 'injuries' in official records.

> "On average, nine people died each day in railway-related mishaps on the MSRS between 2010 and 2019."

Table 6:
Deaths on Mumbai Suburban Railway System (2010-2019)

Year	Railway Zone	Track crossing	Fallen in platform gap	Fallen from running train	Dashing with poles	Others*	Total CR+WR deaths	Deaths per day	Trespass deaths as % of total
2010	Central	1323	2	519	5	472	2321	6.4	58.01%
	Western	829	4	215	8	333	1389	3.8	
	Total	2152	6	734	13	805	3710	10.2	
2011	Central	1207	2	513	10	413	2145	5.9	58.50%
	Western	816	4	223	12	258	1313	3.6	
	Total	2023	6	736	22	671	3458	9.5	
2012	Central	1261	6	566	12	452	2297	6.3	55.89%
	Western	718	15	268	8	235	1244	3.4	
	Total	1979	21	834	20	687	3541	9.7	
2013	Central	1174	6	591	4	495	2270	6.2	52.08%
	Western	652	13	310	4	257	1236	3.4	
	TOTAL	1826	19	901	8	752	3506	9.6	
2014	Central	1216	9	552	2	442	2221	6.1	55.86%
	Western	696	25	245	9	227	1202	3.3	
	TOTAL	1912	34	797	11	669	3423	9.4	
2015	Central	1197	12	545	6	427	2187	6.0	54.51%
	Western	604	28	261	7	217	1117	3.1	
	TOTAL	1801	40	806	13	644	3304	9.1	

Year	Railway Zone	Track crossing	Fallen in platform gap	Fallen from running train	Dashing with poles	Others*	Total CR+WR deaths	Deaths per day	Trespass deaths as % of total
2016	Central	1165	6	446	0	497	2114	5.8	56.15%
	Western	633	7	211	8	229	1088	3.0	
	TOTAL	1798	13	657	8	726	3202	8.8	
2017	Central	1074	5	407	2	440	1928	5.3	54.78%
	Western	577	13	247	10	239	1086	3.0	
	TOTAL	1651	18	654	12	679	3014	8.3	
2018	Central	1022	3	482	9	417	1933	5.3	54.31%
	Western	597	3	229	10	209	1048	2.9	
	TOTAL	1619	6	711	19	626	2981	8.2	
2019	Central	1455	1236				1763	7.4	54.07%
	Western						928		
	TOTAL						2691		
Total deaths on MSRS (2010-2019)							32830	9	55.42%

**Include deaths due to suicides, electric shocks, suicides and natural deaths due to illness.*
Source: Hindustan Times[65] for 2019 data and Mumbai GRP data of respective years accessed by the author.

Figure 2:
Deaths on Mumbai Suburban Railway System (2010-19)

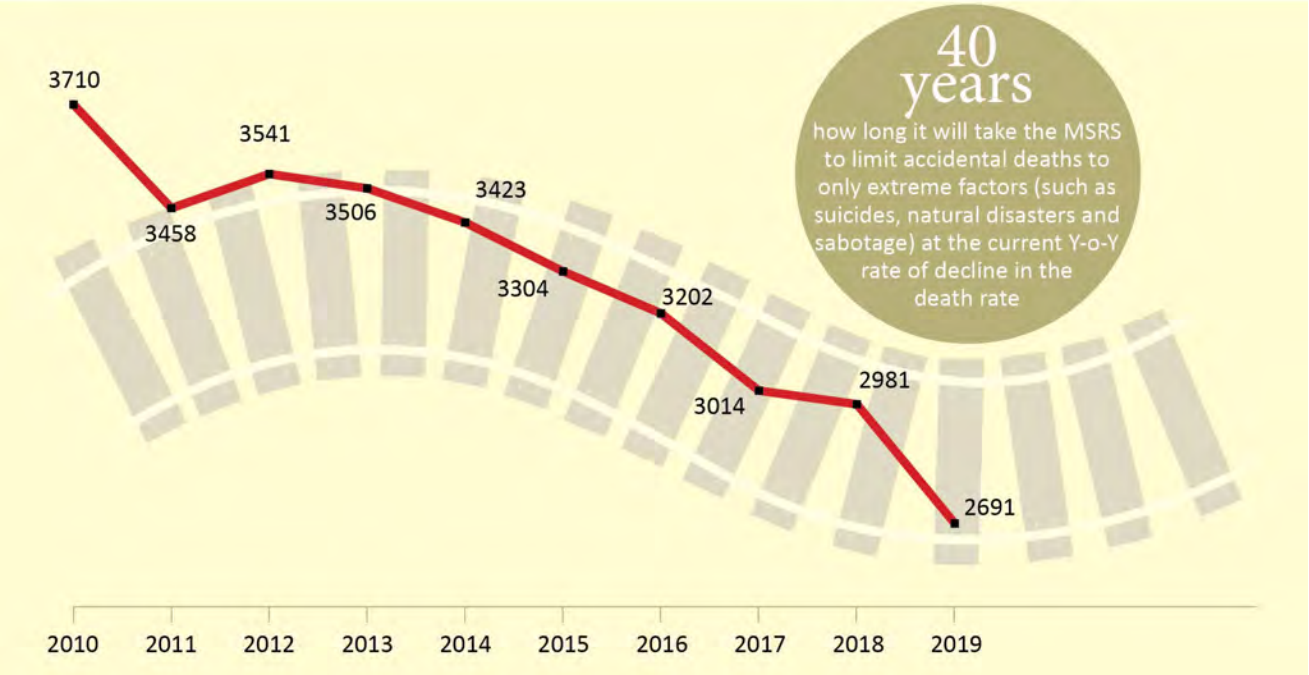
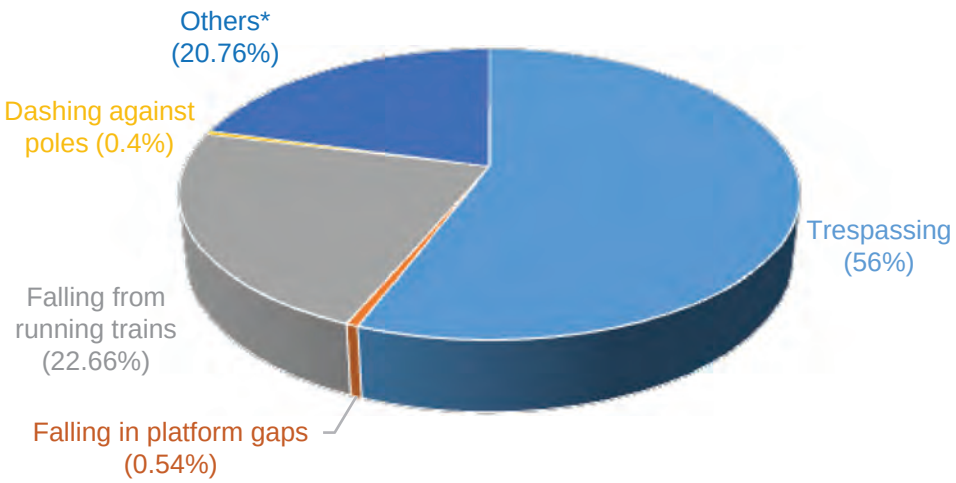


Figure 3:
Causes of deaths on MSRS (2010-2018)



*Includes deaths due to suicides, electric shocks, suicides and natural deaths due to illness.
Source: Mumbai GRP data accessed by the author.[66]

Case Study: Mumbai Suburban Railway System

Accidents like falling off trains or into the gap between the platform and train footboard, and hitting signal poles occur primarily due to severe overcrowding. Despite the MSRS augmenting passenger capacity by 33 percent over the past decade by replacing the existing nine-car rakes with 12-car ones,[72] overcrowding persists. During peak hours, a 12-car train, with a prescribed carrying capacity of 3,505 passengers, reportedly ferries over 5,000 people.[73] Even the induction of 15-car rakes, which the IR consider a panacea for overcrowding,[74] has not had the desired outcome. While additional coaches may increase passenger carriage capacity per rake, the increased headway required by 15-car rakes means fewer trains can operate simultaneously, resulting in overall lower transport output.

In India, incoming trains are often abruptly moved to a different platform just before arrival, forcing passengers to use the tracks instead of foot overbridges to ensure reaching the train on time. Such operational lapses have also resulted in fatal stampedes on foot overbridges.[75,76]

On the MSRS, too, such ad hoc trespassing is a common phenomenon; commuters wait on foot overbridges, cramping the narrow walkway, and making a dash to catch the train once the final arrival platform is announced.

An evaluation of accidental deaths on the MSRS reveals trespassing (55.42 percent) and falling off running trains (22.66 percent) as the two most significant causes of deaths. This is consistent with NCRB data on nationwide railway accidents, which has attributed nearly 71 percent of total accidents to instances of falling off or being run over by trains (see Table 5). Falling from overcrowded trains was the cause of 49 percent of all injuries on the MSRS, followed by getting hit by trains while trespassing (13 percent) (see Table 7).

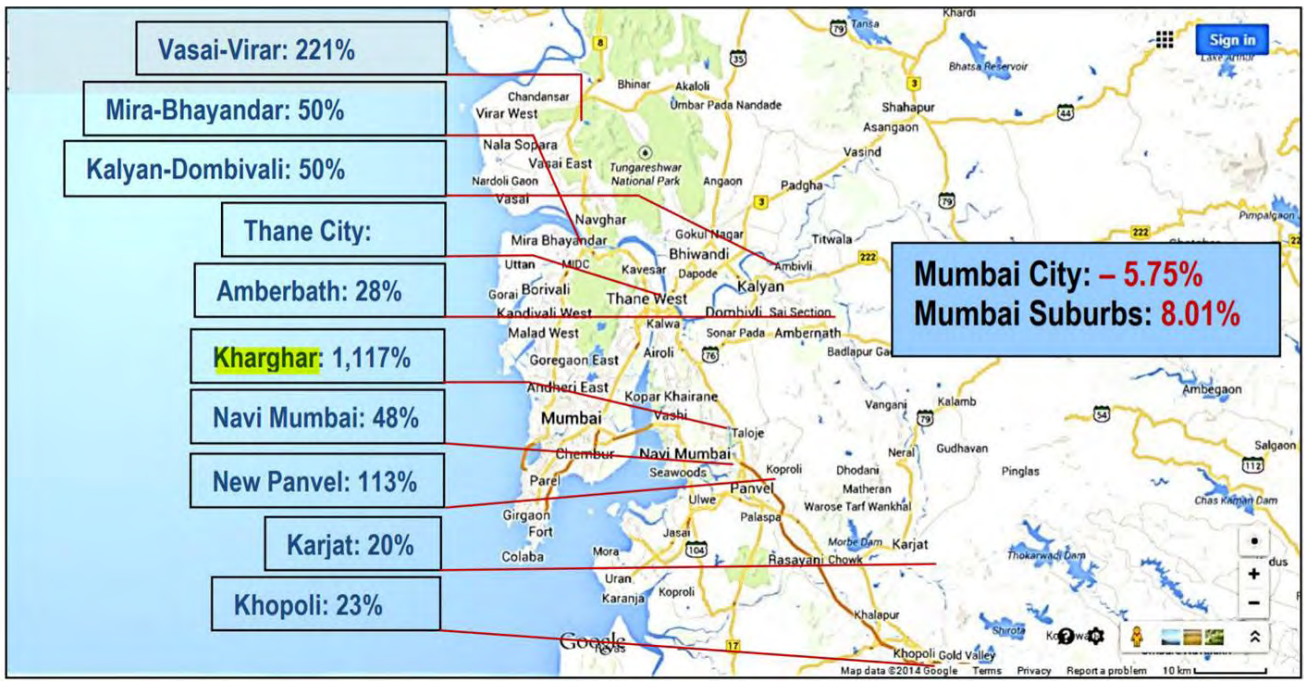
In 2012, a study on reducing trespassing at the 12-most affected stations on the MSRS—Dadar, Kurla, Kanjurmarg, Thane, Thakurli and Kalyan on the CR; and Dadar, Kandivali, Borivali, Bhayandar, Vasai Road and Nalasopara on the WR[77]—recommended design interventions such as foot overbridges, escalators and elevators, railings, green patches, concrete walls and the reorganisation of built spaces and entry and exit gates. At an estimated overall cost of INR 1.30 billion,[78] the project was funded by the savings from the World Bank loan for the second phase of the MUTP. In 2018, a situational analysis by the Mumbai Rail Vikas Corporation (MRVC) to measure the project's effectiveness found that the 12 stations recorded a 90-percent reduction in trespassing.[79]

Table 7:
Injuries on MSRS (2013-2018)

Year	Railway Zone	Track crossing	Fallen in platform gap	Fallen from running train	Dashing with poles	Others*	Total CR+WR injuries	Injuries Per day	Falling from train injuries as % of total
2013	Central	305	4	1082	34	637	2062	5.6	54.13%
	Western	178	13	714	36	315	1256	3.4	
	Total	483	17	1796	70	952	3318	9.1	
2014	Central	321	13	1013	44	671	2062	5.6	51.96%
	Western	165	26	701	33	312	1237	3.4	
	Total	486	39	1714	77	983	3299	9.0	
2015	Central	305	11	1004	52	728	2100	5.8	50.67%
	Western	163	15	693	37	341	1249	3.4	
	Total	468	26	1697	89	1069	3349	9.2	
2016	Central	237	12	786	29	792	1856	5.1	55.45%
	Western	142	7	712	56	590	1507	4.1	
	Total	379	19	1498	85	1382	3363	9.2	
2017	Central	241	4	763	30	767	1805	4.9	42.87%
	Western	135	2	671	60	672	1540	4.2	
	Total	376	6	1434	90	1439	3345	9.2	
2018	Central	207	5	898	47	763	1920	5.3	47.30%
	Western	116	3	686	43	581	1429	3.9	
	Total	323	8	1584	90	1344	3349	9.2	
Total injuries (2013-18)		2515	115	9723	501	7169	20023	9.1	48.58%

**Includes deaths due to suicides, electric shocks, suicides and natural deaths due to illness.*
Source: Mumbai GRP data of respective years accessed by the author.[71]

Figure 4:
Population explosion in MMR (2010-2011)



Source: Image created by the author from Google Maps using Census 2011 data

A 2014 study examining 22 heavy trespassing-prone mid-section areas recommended interventions like constructing 26 new foot overbridges, 36 escalators, 26 elevators and other amenities, at a total estimated cost of INR 3.17 billion.[80] The project has since been clubbed with the third phase of the MUTP.

Boosting MSRS capacity

The complete saturation of the MSRS[81] has diminished the efficacy of all the mega projects aimed at capacity enhancement. With just one Metro line operational and eight others under construction, the MSRS remains the MMR's main transportation lifeline. Even as it has expanded its services to the MMR's newer suburbs, the MSRS has struggled to keep pace with the region's growing population.[82]

Concerted efforts to improve safety and enhance the commuter experience on the MSRS came with introducing the MUTP in 2002.[83] Initiated jointly by the IR and Government of Maharashtra with financial assistance from the World Bank, the MUTP was the city's first project to find long-term solutions to Mumbai's traffic and transportation woes. While the road traffic and transport component of the MUTP is implemented by the Mumbai Metropolitan Region Development Authority, the Municipal Corporation of Greater Mumbai and its subsidiary Brihanmumbai Electric Supply and Transport, the rail component is implemented by the MRVC. The MRVC was established in 1999 as a joint venture between the IR and the Maharashtra government with the primary mandate of executing all MUTP projects.

MUTP-1: The key MSRS-related projects under MUTP's first phase included reducing overcrowding by boosting carrying capacity by 35 percent during peak hours; increasing frequency of train services; converting old trains from DC to AC power; and optimising all CR and WR suburban railway corridors.[84] As part of the project, 101 EMU rakes were introduced, an additional Borivali-Virar line on the WR and Kurla-Thane line on the CR were constructed, and the DC-AC conversion on the WR was completed.[85]

> "Various MSRS safety and capacity enhancement projects have been initiated under the Mumbai Urban Transport Project."

Case Study: Mumbai Suburban Railway System

Originally scheduled for conclusion in 2009 at an estimated cost of INR 453 crore, the project ended in late 2011 at a cost of INR 587 crore[86] and has been rated as "moderately satisfactory".[87]

MUTP-2: The project's second phase was jointly conducted by the Maharashtra government, the World Bank and MRVC. The key objectives were: network and rolling stock expansion to increase carrying capacity and reduce overcrowding; service efficiency improvement; and institutional strengthening. The project was to be implemented in two parts—MUTP-2A and MUTP-2B—at an estimated cost of INR 53 billion and was scheduled to be completed in 2015.[88] While the MUTP-2A had a World Bank loan component, the MUTP-2B was funded by the IR and Maharashtra government equally.

The MUTP-2A closed in December 2016. However, several projects under MUTP-2B, including the construction of the sixth line between Mumbai Central and Borivali and the fifth and sixth lines from Mumbai CST to Kurla—critical for the segregation of suburban traffic from the long-distance through trains—are still a work in progress. Thus, many of the perceived benefits of MUTP-2A could not materialise due to the delays in MUTP-2B.[89] The total cost of MUTP-2 has already touched INR 80.87 billion, according to the MRVC.[90,91]

The World Bank has criticised these delays, saying that while the demand has increased since the start of the project, the non-completion of MUTP-2B has essentially held the entire system back and adversely impacted the project performance.[92] Therefore, "instead of overcrowding in trains decreasing, crowding has further increased".[93]

While the completion of the MUTP-2B is still a few years away, the IR and Maharashtra government have already approved the third phase of the project. Split into two sub-projects, the third phase has set more ambitious targets to decongest and expand the MSRS.

MUTP-3: Sanctioned by the Indian government in December 2016,[94] the MUTP-3 is estimated to cost INR 109.48 billion,[95] INR 36 billion of which will be a loan from the China-led Asian Infrastructure Investment Bank.[96] The project includes mid-section trespass control measures, quadrupling of the Virar-Dahanu Road line, a new Panvel-Karjat suburban corridor and the Airoli-Kalwa elevated corridor. With work on the project only starting in 2019, it is unlikely to meet the 2022 deadline.[97]

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At the same time, INR 336.90 billion has been sanctioned by the Indian government for MUTP-3A,[98] which is scheduled to be completed by 2025. The project aims to extend the Harbour Line from Goregaon to Borivali, establish the fifth and sixth lines of the Borivali-Virar corridor and the fourth line of the Kalyan-Asangaon corridor, and create a yard in Kalyan to segregate long-distance and suburban traffic.

The MRVC has also prepared proposals for the fourth phase of the MUTP, to be implemented in three parts at an estimated cost of INR 290 billion.[99]

The pending and upcoming instalments of the MUTP are critical to the MMR's future needs. However, the implemented phases of the MUTP have largely failed to prevent the crowd load on local trains, resulting in high fatality and injury rates.[101]

> "The MUTP is critical to the Mumbai Metropolitan Region's future transportation needs."

Table 8: MUTP-4 Proposed works and cost estimates

MUTP-4A (63-km Panvel-Vasai corridor)		
Proposed infrastructure	**Description**	**Estimated completion cost (INR billion)**
Track gauge	1676 mm (Broad gauge)	9.78
Traction system voltage	25 kV AC	
Rolling stock	Normal EMU, 3600 mm wide	
Number of stations	22 (11 new stations)	
Travel time	1 hr 10 min	
MUTP-4B (33.8-km CST-Thane underground suburban corridor)		
Track gauge	1435 mm (standard gauge)	155.06
Traction system voltage	25 kV AC	
Rolling stock	3.20 mm wide SS body	
Number of stations	6 (all underground)	
Travel time	21 minutes	
MUTP-4C (55-km CST-Panvel elevated fast corridor)		
Track gauge	1435 mm (standard gauge)	123.31
Traction system voltage	25 kV AC	
Investment mode	Private	
Number of stations	11 (8 elevated, 3 at grade)	
Travel time	5 minutes	
Total estimated cost of MUTP-4		288.15

Source: MRVC[100]

Recommendations: Saving Lives on IR

The MSRS's MUTP experience provides many learnings on enhancing the overall safety of train operations across the IR's national network. Several innovative and short-term measures can prove useful:

Fast-tracking trespass control measures

The IR's capacity augmentation and safety enhancement projects are clubbed together under ambitious long-term megaprojects such as the MUTP. While these projects are significant in the long-term, the effectiveness of urgently required interventions is blunted if there are considerable time delays. For instance, the mid-section trespass control project on the MSRS has been languishing for seven years under MUTP-3.

> "Local authorities and state governments should work to prevent trespassing at all mid-section locations."

The prime function of the IR is to run trains, not prevent trespassing. Providing people with safe passageway at stations and mid-sections through foot overbridges will need close coordination with the central and state governments and other local bodies. The onus lies with the state and local governments to ensure work is not held up due to bureaucratic hurdles, lack of finances or a lack of interest.

At the same time, the Railway Board must decentralise. Its zonal/divisional wings must be empowered to commission all station- and location-specific interventions independently. The minutes of the 22nd meeting of the 'Committee for Effective Development of Mumbai' held on 14 September 2015 show that work to eliminate trespassing at 20 mid-section locations on the MSRS was approved to be "started immediately,"[102] but the delay in the initiation of the MUTP-3 has meant that most of the work is yet to commence.

The onus of preventing trespassing at all mid-section locations lies squarely with the local authorities and state governments, and must be made part of urban planning. For instance, the local corporation and state government did not consider the exponential population growth in the MMR—and the resultant increased activity on the MSRS—in recent decades in their urban plans, resulting in the existing foot overbridges and other such amenities being inadequate to meet the passengers' needs and leading to a high degree of trespassing.

Recommendations: Saving Lives on IR

Deconstructing Timetables

Reconstructing existing timetables can ensure that trains operate in a predictable and straightforward pattern with better punctuality.

The high-density sections of the IR's national network often operate beyond the prescribed capacity; as of 2015, of the 247 high-density sections, 79 worked at over 120 percent of the prescribed capacity, while 23 were running at over 150 percent overcapacity.[103] This is primarily because all traffic categories (ordinary passenger trains/locals/freight) ply on the same route with varying speeds and priorities.[104]

The saturation of the MSRS is primarily because standard 12-coach rakes jostle for track space with the long-distance 24-coach trains. Across India, trains operate with 12, 14, 16 and 18 coaches, running as per varied speed prescriptions.[105] The same routes are also used for freight trains, generally composed of 59 uncovered wagons or 43 covered wagons.[106] Such mixed operations on the same railway routes clog the entire network and impact headway, reducing line capacity. This is also why incoming passenger trains do not have dedicated docking platforms at many stations, triggering mass trespassing to crossover to the new arrival platform.

In 2017, Observer Research Foundation Mumbai undertook a timetable construction project, called Saral, for the WR's suburban operations. The timetable was constructed over eight months by meticulously analysing WR Timetable No. 74 and all available resources. Without adding a single new rake or a single kilometre of new track, Saral could press 130 more trains into service daily—an increase of 10.72 percent with the same number of rakes in operation. Train kilometres were also increased from 46,249.64 to 51,979.41—an increase of 12.39 percent (5,729.77 kilometres in absolute terms). Saral could also enhance the WR's frequency during peak hours by augmenting train kilometres from 8,078 to 8,835, effectively tackling the increase in peak rush. Importantly, under the Saral timetable, almost all trains could get a fixed docking platform, virtually eliminating trespassing.

> "The MUTP is critical to the Mumbai Metropolitan Region's future transportation needs."

Saral performed at 100 percent accuracy when run under different scenario simulations on the IR's RailSys software for route capacity enhancement. It was also found to be superior to the then existing WR timetable to handle contingencies. However, repeated consultations with WR staff and detailed presentations to the Railway Board failed to convince officials of its efficacy.

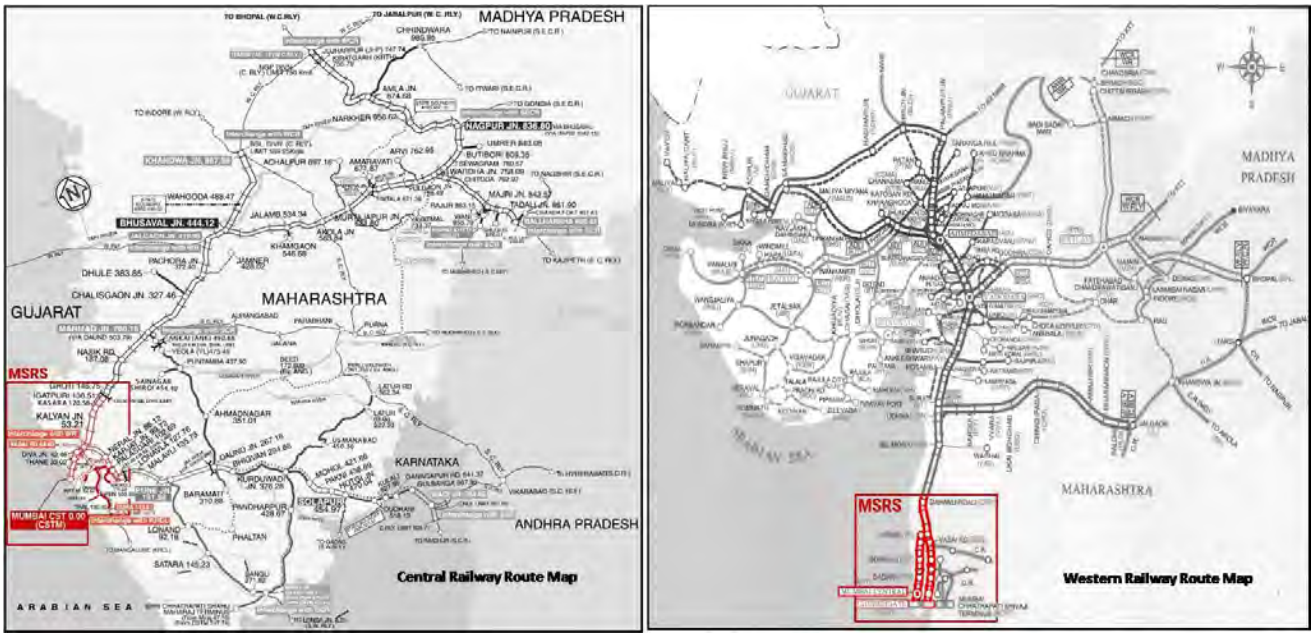
Unified railway zone for Mumbai

Many of the MSRS's operational hurdles are because it is governed independently by the CR and WR. The WR manages the entire traffic operations covering Gujarat, Madhya Pradesh and Rajasthan, while the CR extends from Itarsi in Madhya Pradesh to Nagpur in Maharashtra to Gulbarga in Karnataka. For both, the MSRS is a small part of their mandate (see Figure 5). The CR and WR priority are freight operations, an important revenue source for the IR, while the MSRS caters to passenger commute.

Establishing a unified suburban railway zone for Mumbai will have several strategic and operational benefits. The CR and WR operate and maintain their respective rakes in the sheds and workshops under their control. A pooling of resources following a merger into a railway zone of the CR and WR's suburban divisions will generate synergy to boost revenues and raise the overall standards of commuter safety and travel. The MSRS contributed nearly 35 percent of the IR's 23 million riders in 2018-19.[109] Given the high commuter volumes on the MSRS, converting it into a railway zone is crucial for improved efficiency and operations.

Going forward, the IR must realise that the real purpose of the MSRS is as a metropolitan public transport provider. As the national transporter, the IR has no role to play in the operations of the MSRS. The need for "integrating the metro and suburban rail systems under a single management in partnership with the respective state/city authorities" has already been recognised in IR's Vision 2020 plan.[110] Such integration should be independent of the Ministry of Railways. Well-functioning models of separate railway operations, such as the Delhi Metro Rail Corporation and the Mumbai Metro One, can be emulated to create an independent railway authority for the MSRS.

Figure 5:
MSRS (in red) as part of the CR and WR route network



Source: CR and WR websites[107],[108]

Recommendations: Saving Lives on IR

Need for political will

Since 2010, Maharashtra, Uttar Pradesh and West Bengal have consistently been ranked as India's top-three states to report the maximum number of fatalities resulting from railway accidents (see Table 9). According to NCRB data, the three states account for 48 percent of all railway accidents, excluding level crossing incidents, and 43 percent of all 'inconsequential' deaths.

Tamil Nadu, Bihar, Haryana, Andhra Pradesh and Madhya Pradesh periodically round up the top five states to report railway fatalities. Together, the top-five states log 62 percent of all accidents and 58 percent of all deaths.

Political leaders and elected representatives must use their presence on the consultative railway users' committees at the divisional, zonal and national levels to push for improved commuter safety instead of simply pandering to their electorates through the introduction of new trains, new mid-section halt stations and new routes. Enhanced railway capacity and safety will also bring political dividends.

> "Of all states, Maharashtra, UP and WB have the highest number of fatalities from railway accidents."

Table 9: Railway accidents and accidental deaths – Top 3 states

Year	2015	2016	2017	2018	2019
Total railway accidents*	29419	25927	27197	27643	27987
Total railway accidents (Top 5 reporting states)					
Maharashtra	7806	7160	6818	6349	6338
Uttar Pradesh	4431	3301	3016	3272	3980
West Bengal	2726	2690	2723	2756	2876
Total accidental deaths*	26066	22051	23959	24545	24619
Total railway accidental deaths – Top 3 reporting states					
Maharashtra	4719	4462	4017	3801	3916
Uttar Pradesh	4472	3432	2856	3095	3521
West Bengal	2545	2509	2687	2722	2832

**Excluding level crossing accidents and deaths*
Source: Compiled by the author from NCRB's 'Accidental Deaths and Suicides in India' reports of respective years.[111]

Conclusion

The IR may have already delivered on its promise of zero deaths from consequential accidents by 2020. Yet thousands of fatalities due to untoward incidents continue to occur. Part of the solution lies with the IR. Instead of distancing itself from the problem, it must accept the challenge and undertake capacity enhancement projects.

To control trespassing, for instance—which is a significant cause of fatalities—the IR must empower its zonal and divisional heads to make independent decisions regarding prioritising and executing urgent work. The IR must also be willing to experiment with innovative ideas, such as the Saral timetable, to rationalise its timetable construction practices. If done through a participatory approach using its existing zonal and divisional consultative bodies, timetable rationalisation will free up the saturated network for more train operations at zero to minimal cost.

The integration of the human and technical resources currently under the independent purview of CR and WR through a unified suburban railway zone for the MSRS will enable the IR to minimise the death toll by 27 percent. However, no solution to the larger problem of untoward railway accidents and deaths can ever be achieved unless all stakeholders collectively take up the challenge with a commitment to the cause. ORF

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