Fund Deployment Framework for Rashtriya Rail Sanraksha Kosh (RRSK) – A Discussion Note

****

Bibek Debroy[1] and Kishore Desai[2]

1. Background and Context

1.1 Absolute safety in Railways is a topmost priority for the Government. Railway accidents not only lead to immense loss of lives and property, but also impact the psyche of general public for whom railways is a primary mode of transport. Commenting on safety, a Parliamentary Standing Committee on Railways recently noted[3] "*The Committee wish to remind the Ministry that a rail accident does not merely involve damage to rail infrastructure alone. There is a huge cost to society as well, society pays dearly through lost lives, lost livelihood, loss of productivity, disability, medical expenses, disruption of traffic, loss of the wagons etc. However the highest cost is the loss of passenger confidence which may translate into loss of revenue in future for the railways. The Committee are of the firm view that taking the issue of safety and investments on safety lightly may cost the railways very dearly in terms of share in transportation of passenger and freight and thereby decrease in Revenues*".

1.2 From time to time, the Ministry of Railways (MoR) has been taking various initiatives to improve safety in its system. Expert Committees in the past have conducted detailed review of safety related aspects and recommended measures to correct systemic deficiencies. Recently, in 2011, a High Level Safety Review Committee (HLSRC 2011) under the Chairmanship of Dr. Anil Kakodkar examined all technical and technology related aspects in connection with safe running of train services in the country. The HLSRC recommended a range of inter-departmental measures requiring an investment of about INR 1 lakh crores. In 2012, another expert committee under the Chairmanship of Shri Sam Pitroda deliberated on modernization of Indian Railways (IR). As part of its proposals, this committee also recommended safety related measures entailing investments of around INR 40,000[4] crores.

1.3 Keeping the above recommendations in mind, the fund requirement for IR was assessed[5] by Adviser/Safety, Adviser/Infra and AM/Budget, which was reviewed in Board meeting on 01.08.2012 and critical review was done thereafter. After final review by AM/Budget and Advisor/Safety on 28.08.2012, an investment requirement of about INR 1.0 lakh crores was projected by the MoR. Since then, the MoR has continued implementing necessary initiatives including many of the expert committee recommendations particularly that of HLSRC[6]. However, availability of funds remained constrained vis-à-vis the requirements.

---

[1] Member, NITI Aayog, Government of India

[2] Officer on Special Duty, NITI Aayog

[3] Source: 12th Report of the Parliamentary Standing Committee on Railways on "Safety and Security in Railways" submitted December 2016

[4] Source: Note on "Creation of RRSK for enhancement of safety of Indian Railway System" by MoR

[5] Source: Note on "Creation of RRSK for enhancement of safety of Indian Railway System" by MoR

[6] Out of 106 recommendations of HLSRC, 68 recommendations have been fully accepted and 19 partially accepted. Of these, 22 recommendations have been fully implemented and the remaining recommendations

1.4 To expedite implementation of safety works, the Ministry set up an internal committee[7] of senior Railway officials to consider the need for a dedicated safety fund along the lines of Special Railway Safety Fund (SRSF) created in 2001. Building upon the earlier studies, the committee outlined measures (department-wise works) requiring an overall investment of about INR 1,54,000 crores. Out of this, funding of around INR 1,19,000 crores was proposed to be met through a dedicated safety fund called "Rashtriya Rail Sanraksha Kosh" ("RRSK"). The balance was proposed to be met from IR's own sources.

1.5 Subsequently, after discussions between MoR and Ministry of Finance, the Finance Minister announced creation of "Rashtriya Rail Sanraksha Kosh" ("RRSK") with a corpus of INR 1 lakh crore over a period of 5 years. Para 74 of the Union Budget 2017-18 speech stated "*For passenger safety, a Rashtriya Rail Sanraksha Kosh will be created with a corpus of Rs. 1 lakh crores over a period of 5 years. Besides seed capital from the Government, the Railways will arrange the balance resources from their own revenues and other sources. Government will lay down clear cut guidelines and timeline for implementing various safety works to be funded from this Kosh.*"

1.6 Pursuant to the Budget 2017-18 announcement, the Ministry of Railways requested[8] Dr. Bibek Debroy (Member, NITI Aayog) to extend help in the task of "*identifying other critical areas and guiding principles for deployment of RRSK funds for bringing out perceptible improvement in safety scenario over Indian Railways*".

1.7 Thereafter, a recommendatory framework to deploy RRSK funds was submitted to the Government for review and necessary action. In the meantime, given the critical importance of safety, a larger public debate on this subject is also being facilitated. Relevant portions of the analysis are being shared to increase awareness about various policy measures being taken by the Government to make IR 100% safe.

2. Objective and Structure of this Note

2.1 Para 74 of the Union Budget speech 2017-18 makes it amply clear that the fundamental purpose of creating RRSK is to ensure funds for implementing Safety works on Railways. That said, it is not easy to clearly delineate safety works from those that indirectly enhance safety in Railways. Take for instance network decongestion projects such as doubling or tripling. A decongested network is prone to accidents due to limited margin for error and hence decongesting such network enhances railway safety. So one can argue a case to consider network decongestion projects as part of safety works. Besides this, safety also needs an integrated inter-departmental approach. For example, even if track condition is fine, a running train may derail due to defects in wheels or other bogie components. So if funds are deployed to strengthen track infrastructure only, it would not serve a meaningful purpose. While we acknowledge such complexities, we are cognizant of the size of RRSK corpus available every year. Hence, while suggesting an appropriate framework for deploying RRSK funds, an independent objective attempt to analyse various aspects of Railway accidents has been made. Based on key insights drawn from this

---

are under various stages of implementation. Source: 12th Report of the Parliamentary Standing Committee on Railways on "Safety and Security in Railways" submitted December 2016

[7] Committee comprising ED/CE/Projects, ED/FX-I, ED/Mechanical/Projects, ED/Signal/Development and ED/EEM was set up vide Railway Board letter no. ERB-1/2015/23/44 dated 21.10.2015. The Committee submitted its report on 17.12.2015

[8] Source: MoR letter no. 2015/CE-II/Plg/1 dated 21.02.2017

analysis, guiding principles have been suggested keeping in mind the funding limitations as well.

2.2 With the above explanatory background, the following are the key objectives of this note:

a) To suggest guiding principles for deployment of RRSK funds so that a perceptible improvement in safety scenario can be achieved in the Indian Railway system;

b) To suggest other critical areas that would enable MoR utilize RRSK funds in an efficient and effective manner;

c) Review of RRSK funding drivers, such as the safety strategy (department-wise actions identified by MoR), quantum of investment requirements (whether they are appropriate or not), technologies proposed by MoR to improve safety in the IR system etc., has not been undertaken in this note. The scope of the study is primarily limited to items a) and b) above.

2.3 For undertaking the necessary analysis to meet the above objectives, the following structure is followed:

a) Section 3 - Analysis of Accidents: This section aims to analyse various aspects of accidents in an objective data-driven manner. Key questions such as which types of accidents are the biggest concerns in terms of loss of lives and injuries, which directorates require more funding support, where do derailments occur more frequently etc. are examined critically.

b) Section 4 - Mapping Sources of funds & expenditure of existing safety works: To map sources of funds and expenditure pattern practiced currently for implementing inter-departmental safety works.

c) Section 5 – Overview of RRSK: Outlining the fund structure and key elements of RRSK.

d) Section 6 – Safety Investment Projections: Presenting the overall safety investment needs (department-wise and work-wise breakup) as estimated by IR's committee of senior officials.

e) Section 7 – RRSK Fund Deployment Framework: Suggestions related to appropriate framework and activity priorities for deploying RRSK funds.

f) Section 8 – Other related suggestions: Related suggestions to complement RRSK funds for overall improvement in safety situation.

g) Section 9 – Conclusion

2.4 The next section analyses various aspects of accidents.

3. Assessment of Accidents: The fundamental driver for RRSK fund deployment framework

3.1 MoR records details related to every Consequential Accidents on its system. Consequential Accidents[9] are defined as train accidents having serious repercussions in terms of loss of human life, human injury, loss to Railway property or interruption to Rail

[9] Source: Railway Board letter no. 2000/Safety(A&R)/19/20 dated 31.10.2000

Traffic for more than specified threshold values. Consequential accidents are further classified into the following categories:

a) Derailments (accidents on account of derailment or trains);
b) Level Crossing (LC) related accidents (accidents on road-rail interfaces such as Manned and Un-manned LCs);
c) Collisions;
d) Fire related accidents and
e) Others / Miscellaneous (this covers all other incidents not covered above. For example, accidents due to natural incidents: landslide, flash floods etc., sabotage, improper loading/unloading, train running over cattle or any fixed structure etc.)

3.2 In this document, Accidents primarily mean "Consequential Accidents" as specified above.

Assessment of Accidents (by categories): LC and Derailment accidents constitute 90% of all accidents on IR system

3.3 Review of data related to consequential accidents on IR network indicates that over the six year period 2012-13 to 2016-17, a total of 586 accidents took place on IR network. These accidents led to 1011 casualties and left 1634 people injured. Year-on-Year (y-o-y), the total number of accidents on IR network has declined (from 12 accidents in 2012-13 to 104 in 2016-17), with 2014-15 being an exceptional year. However, in terms of casualties and people injured, there are no clear y-o-y trends. The raw data of consequential accidents (including the breakup of various aspects, by accident classifications) is presented below.

Table: Details of consequential accidents (2012-13 to 2016-17 and cumulative)

S. No.	Description	2012-13	2013-14	2014-15	2015-16	2016-17	Cumulative
1	**Total Number of Accidents**	122	118	135	107	104	586
2	**Break-up of Accidents by types**						
	Derailments	49	53	63	65	78	308
	Manned LC's	5	4	6	6	0	21
	Un-manned LC's	53	47	50	29	20	199
	Collisions	6	4	5	3	5	23
	Fire	9	7	6	0	1	23
	Others	0	3	5	4	0	12
3	**Total number of casualties by Accident types**	204	152	292	122	241	1011
	Derailments	5	6	104	36	196	347
	Manned LC's	18	6	31	12	0	67
	Un-manned LC's	123	98	130	58	40	449
	Collisions	27	1	15	1	5	49
	Fire	31	35	0	0	0	66
	Others	0	6	12	15	0	33

S. No.	Description	2012-13	2013-14	2014-15	2015-16	2016-17	Cumulative
4	**Total number of Injured persons by Accident types**	381	234	457	188	374	1634
	Derailments	159	93	265	100	327	944
	Manned LC's	25	2	21	10	0	58
	Un-manned LC's	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

Source: Railway Board, Ministry of Railways

3.4 Analysis of the above data, cumulatively over the period 2012-13 to 2016-17, throws the following crucial insights:

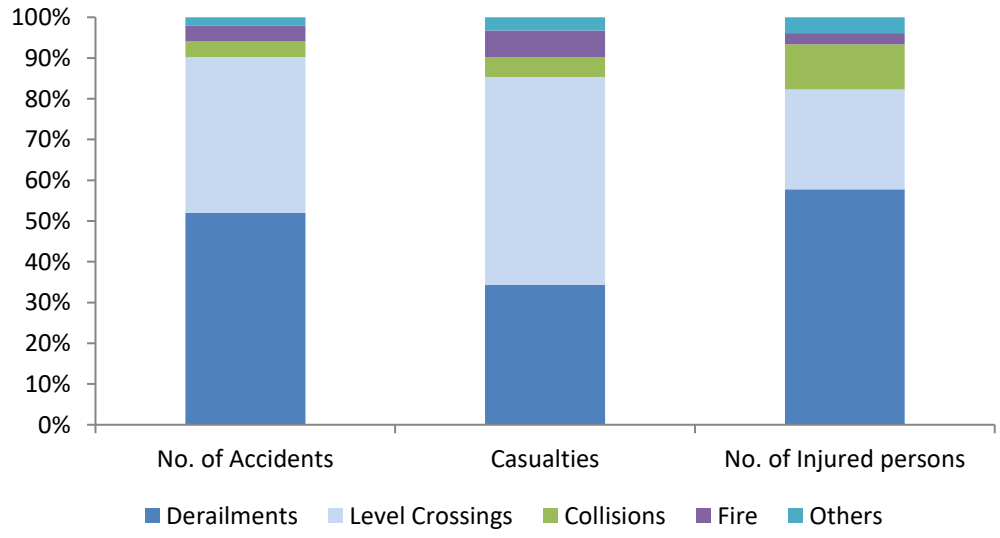
a) Derailments accounted for more than 50% of the total consequential accidents while Level Crossing (LC) related accidents (on both manned and unmanned) accounting for about 40%. Together, Derailments and LC related accidents accounted for 90% of total accidents on IR networks;

b) 51% of the total casualties over the above period were on LC related accidents, while about 35% of casualties on derailments. Together, Derailments and LC related accidents accounted for about 85% casualties;

c) Similarly, derailments and LC related accidents together accounted for about 82% injured persons.

3.5 The analysis above is presented graphically below. Therefore, for a meaningful reduction in number of accidents and casualties/injured persons, initiatives for reducing/eliminating Derailments and Level Crossing accidents have to be accorded highest priority.

Figure: Analysis of number of accidents, casualties and injured persons by accident classification (2012-13 to 2016-17 cumulative)



Source: Analysis of the data above

Assessment of Accidents (by directorate-wise responsibility): Civil Engineering Directorate needs priority focus

3.6 The Ministry of Railways has an established process for identifying and fixing responsibilities post an accident. This process facilitates cause analysis and helps MoR delineate system deficiencies responsible for each accident. For instance, say that review of a derailment accident shows that the primary cause for that derailment is "Rail fracture". In this case, the directorate-wise responsibility for the above derailment accident would be fixed onto the Civil Engineering Directorate. On the other hand, there may be instances where multiple causes together may have contributed towards an accident. For such cases, the directorate-wise responsibility would be apportioned equally to each directorate responsible for that accident.

3.7 The directorate-wise responsibility mix is typically classified into the following categories:

a) Engineering (Civil) (accidents where cause relates to failure on account of Engineering Directorate – failure of tracks, points, turnouts, fittings etc.);
b) Mechanical (accidents where cause relates to failure of Mechanical Directorate – Locomotives, Coaches, Wagons, Wheels etc.);
c) Electrical (cause relates to failure of Electrical Directorate – OHE's, Traction Distribution assets, EMU's, E-Locomotives etc.);
d) Signal & Telecommunications (S&T) (cause relates to that of S&T Directorate – signaling systems, interlocking systems, communication etc.)
e) Traffic & Commercial (cause relates to Traffic & Commercial accounts – faulty loading, unloading, operations without correct setting and securing of routes etc.)
f) Failure other than Railway Staff (cause relates to Non-Railway Staff – failure of Road users, bus/car/two-wheelers/trucks etc.)
g) Incidental (cause relates to incidents: landslide, flash floods etc.)
h) All Others (cause relates to reasons that have not been covered above)

3.8 Review of the accident data over the period 2012-13 to 2016-17 shows that, on a cumulative basis, "Failure Other than Railway Staff (FORS)" and "Engineering (Civil)" directorate have been responsible for the maximum number of accidents (234.5 and 158.8 number of accidents respectively out of a total 586 number of accidents over that period). This is understandable as the previous section clearly showed that Level Crossings related accidents (cause – Failure Other than Railway Staff) and Derailments (one of the primary causes being track defects) account for the bulk of railway accidents. On a y-o-y basis, the performance of Engineering Directorate shows consistent deterioration (i.e the number of accidents on account of Engineering Directorate have increased y-o-y). On the other hand, various steps for securing level crossings (by manning them, developing Road Over Bridges (ROBs), Road Under Bridges (RUBs) etc.), have helped reduce accidents on account of FORS over the above period. The data for directorate-wise responsibility mix is presented below:

Table: Responsibility Mix (Number of Accidents department-wise) over 2012-13 to 2016-17

Directorate-wise	2012-13	2013-14	2014-15	2015-16	2016-17	Cumulative
Engineering (Civil)	25	29.5	31.5	33.3	39.5	158.8
Mechanical	11	8.3	15.5	12	12.3	59.1
Electrical	4	8.3	7.5	4.5	6.5	30.8
Signal & Telecom.	4.5	6	1	2.8	2.3	16.6
Traffic & Commercial	7	1.8	9.5	5.3	6.8	30.4
Failure Other than Railway Staff	59	57	57	38	23.5	234.5
Incidental	7	4	8	9	7	35
All Others	4.5	3.1	5	2.1	6.1	20.8
Total	122	118	135	107	104	586

Source: Railway Board, Ministry of Railways

***Note**: Several data points in the above table are in decimals (and not whole numbers). This is because, per detailed review of each accident, its cause can be attributed to multiple departments. For example, assume one derailment takes place because of both wheel and track related infirmity. In such a case, that derailment accident will be attributed to both Engineering and Mechanical directorate. Hence each of these directorates would account for 0.5 and 0.5 number of accidents.*

3.9 Analysis of the above data, cumulatively over the period 2012-13 to 2016-17, throws the following crucial insights:

a) Non-railway users are responsible for the largest number of Railway accidents over the above period (about 40%). This is in sync with the analysis undertaken above (category-wise accidents) as LC related accidents accounted for about 40% of the total accidents;

b) Previous analysis showed that derailments accounted for more than 50% of total accidents. However, Engineering Directorate was responsible for 27% of all accidents. These observations imply that all derailment incidents can't be solely attributed to track related defects. While failure of engineering assets (tracks, welds etc.) would derail a running train, failure of wheel and other rolling stock components can also potentially derail a train. Hence, other directorates such as Mechanical, Electrical etc. also contribute to derailment incidences. That said, Engineering Directorate can be still considered to account for the largest share of all derailments.

c) On a y-o-y basis, there has been a 60% increase in the number of accidents for which Engineering Directorate was responsible.

d) Together, Engineering Directorate, Mechanical Directorate, Electrical Directorate and Other than Railway Staff (primarily road-users) are responsible for about 83% of all accidents over the above period;

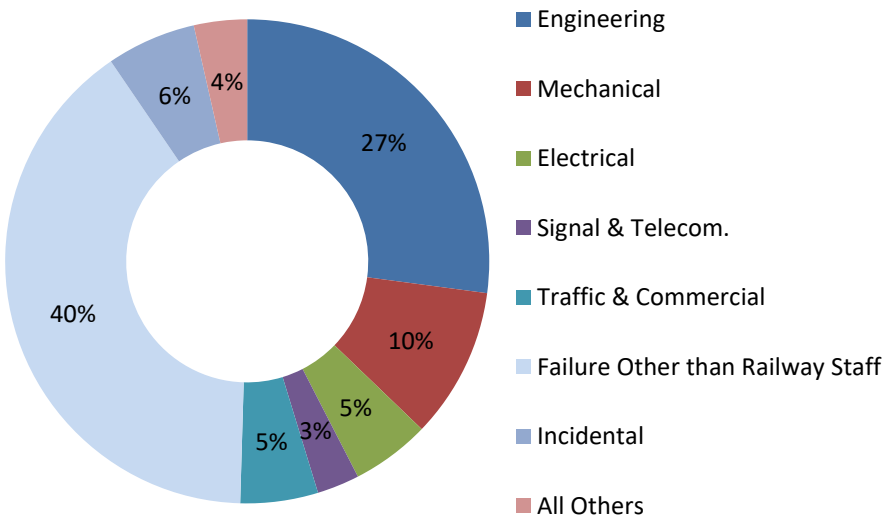
3.10 The cumulative share of responsibility-mix is presented graphically below. Assessment of accidents (category-wise) in the last section showed that, for a perceptible improvement in railway safety, initiatives for reducing/eliminating Derailments and Level Crossing accidents have to be accorded highest priority. The department-wise responsibility analysis in this section shows that the following departments need to be specially focused on for safety improvement:

a) Level crossing works to eliminate failures on account of Other than railway staff (road-users);

b) Civil Engineering department works need special focus given its major contribution to derailments and its y-o-y performance record;

c) Works undertaken by other directorates such as Mechanical and Electrical focused on improving wheel and rolling stock safety to eliminate/minimize derailments.

Figure: Analysis of Accidents (Directorate-wise responsibilities) cumulative over 2012-13 to 2016-17



Source: Analysis of above data

Analysis of Accidents (contribution of human failures): About 87% of accidents can be traced to human errors

3.11 Continuing the above analysis, on a cumulative basis over the period 2012-13 to 2016-17, data indicates that human failures contributes to about 87% of all accidents as compared to failure of equipment, technology or other reasons. This failure can either be of railway staff (such as gangmen, loco-pilots, traffic and commercial staff etc.) or non-railway people. For example, level crossing accidents happen because road users (bus drivers, car drivers, truck/lorry drivers etc.) fail to avoid crashing with a running train. Similarly, derailments can happen due to staff's failure in timely detection of track or rolling stock component (wheels, gear parts, bearings etc.) defects, failure of loco pilots in adhering to speed restrictions, Signal Passing at Danger (SPAD) etc. Failure of railway staff contributes to about 47% of all such accidents while the balance being contributed by non-railway people.

3.12 Further, y-o-y trends indicate that the share of accidents on account of failure of railway staff have been continuously increasing over the period 2012-13 to 2016-17. For example, in the year 2016-17, while human failure accounted for about 83% of all accidents, failure of railway staff accounted for 62% of that. This is a worrying trend as it shows that there significant reliance on human inputs continues on activities which are safety critical. The table below presents break-up of number of accidents attributed to railway staff, non-railway staff and other reasons over the period 2012-13 to 2016-17.

Table: Accidents on account of failure of railway staff, non-railway staff and others (2012-13 to 2016-17)

Failure-wise	2012-13	2013-14	2014-15	2015-16	2016-17	Cumulative
Failure of Railway Staff	46	51	60	55	64	276
Failure of other than Railway Staff	59	57	58	38	22	234
Failure of Equipment	6	3	4	2	2	17
Sabotage	3	3	3	1	2	12
All other factors	8	4	10	11	14	47
Total no. of accidents	**122**	**118**	**135**	**107**	**104**	**586**
Failure of Railway staff as a % of Total	37.7%	43.2%	44.4%	51.4%	61.5%	47.1%
Failure of Railway & Non-Railway staff as a % of Total accidents	86.1%	91.5%	87.4%	86.9%	82.7%	87.0%

Source: Railway Board, Ministry of Railways

3.13 The key take away from the above arguments is that initiatives that reduce potential of human errors in IR system such as automated inspection & asset monitoring techniques, replacement of overaged assets (tracks, signaling etc.) and upgradation of asset maintenance infrastructure etc. needs priority emphasis.

Deep-diving Derailments (department-wise and route-wise assessment)

3.14 The paragraphs above clearly indicate that other than LC related accidents, derailments are the biggest cause of concern for Indian Railways. While the onus of LC related accidents falls to a large accident on road users, derailments happen due to railway system deficiencies. That derailment is linked to inter-departmental failures, adds to its complexity.

3.15 Data shows that over the period 2012-13 to 2016-17, Engineering Directorate contributed to about 44% of derailments that happened over this period. This implies that failure of track related infra has been the most important cause of derailments. This observation corroborates the findings presented earlier that Engineering Directorate contributes to the largest share of derailments. Mechanical and Electrical Directorate together have contributed to about 16% of derailments over that period. Together, these three directorates have contributed to 60% of all derailments. The table below presents the department-wise data for derailments over the above period.

Table: Department-wise contribute to derailments (number of derailments)

Derailments (department-wise breakup)	2012-13	2013-14	2014-15	2015-16	2016-17	Cumulative	% Share
Mechanical	4.5	5	7.5	8.5	8	33.5	11.4%
Engineering	17	22	24	28	37.5	128.5	43.6%
S&T	3.5	5	0	3	2.4	13.9	4.7%
Traffic/Coml	3	1	4.5	4.5	6.8	19.8	6.7%
Electrical	1	2	5	2.5	2	12.5	4.2%
Incidental	7	4	8	9	7	35	11.9%
All Others	12	10	12.5	7	9.8	51.3	17.4%
Total	48	49	61.5	62.5	73.5	294.5	100.0%

Source: Railway Board, Ministry of Railways

3.16 Further, it is also important to note that derailments happen mainly on Broad Gauge (BG) routes. IR classifies its routes under various classes (A, B, C, D, D Special etc.). The details of such classes along with examples of key routes that fall into them is given in the table below.

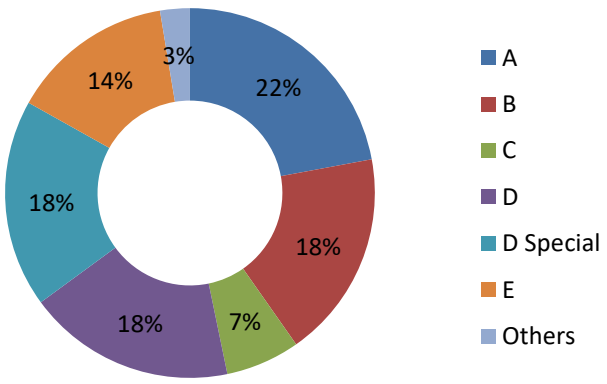
Table: Details of route classification in IR network

Classification	General Features	Some Examples
A	Lines in BG sections typically rated for speeds up to 160 km/h	High Density Network (HDN) routes such as New Delhi – Howrah, New Delhi-Mumbai Central, Howrah – Nagpur-Mumbai etc. Many of these routes have capacity utilization of more than 100%.
B	Lines in BG sections typically rated for speeds up to 130 km/h	Allahabad-Katni-Jabalput-Itarsi-Bhusaval, New Delhi-Kalka, Kharagpur-Vijaywada, Vadodara-Ahmedabad etc.
C	Suburban networks	Mumbai suburban system, Kolkata suburban system etc.
D	Lines in BG sections typically rated for speeds up to 100 km/h	Guntur-Guntakal, Salem-Bayappanahalli, Securandabad-Dronachalam etc.
D Special	Lines in BG sections typically rated for speeds up to 100 km/h with high traffic density or high expected traffic growth	Lucknow-Kanpur, Lucknow-Sultanpur-Varanasi, Nagda-Bhopal, Kharagpur-Adra, etc.
E	Lines in BG sections typically rated for speeds below 100 km/h	
All others	Other categories including Narrow Gauge and Meter Gauge lines	

Source: P-Way track classifications, irfca.org website

3.17 Analysis of route-wise derailments indicates that about 83% of derailments that happened over the above mentioned period were in A, B, C, D and D Special class. High density routes typically considered in A class contributed for about one-fourth (22%) of total derailments. While routes under A and B class together accounted for about 40% of all derailments, D and D Special class contributed to a similar quantum of about 36%. The graph below shows the route-wise derailments.

Figure: Break-up of derailments across IR network (class-wise routes) cumulatively over 2012-13 to 2016-17



Source: Railway Board, Ministry of Railways

3.18 While detailed analysis of derailments (directorate-wise mix) largely corroborates findings of the previous paragraphs, route-wise analysis indicates that derailments are largely concentrated in A, B, D and D Special networks of IR.

Summary & Conclusions

3.19 Detailed analysis of data in the paragraphs above clearly helps dissect various key aspects of Railway accidents: share of various types of accidents, directorate-wise responsibility of these accidents, contribution of human failures as compared to equipment or technology failure and so on. Based on the above assessments, the following key insights emerge:

a) Together, Derailments and LC related accidents accounted for 90% of total accidents, 85% casualties and 82% injuries on IR networks. Initiatives for reducing/eliminating Derailments and Level Crossing accidents therefore need to be accorded highest priority;

b) Engineering Directorate, Mechanical Directorate, Electrical Directorate and Other than Railway Staff (primarily road-users) are responsible for about 83% of all accidents over the above period. Out of this, Civil Engineering and Other than Railway Staff account for 67% of accidents. Meaning most derailments and LC accidents are accounted by these stakeholders. On a y-o-y basis, there has been a 60% increase in the number of accidents for which Civil Engineering Directorate was responsible. With such disproportionate contribution to accidents and deterioration of y-o-y record, there is clearly a strong case for ensuring highest priority to Engineering works. This implies that, besides works for reducing/eliminating LC accidents, works undertaken by Civil Engineering, in particular, and other directorates - Mechanical and Electrical that lead to reduction/elimination of derailments need to be targeted on priority. Such works may involve programs enhancing safety of track and rolling stock (particularly wheels and bogie component in rolling stock). Further, considering the y-o-y trends for Civil Engineering department, works related to Civil Engineering need stronger prioritization;

c) Human failures contribute to about 87% of all accidents. Within human failures, contribution of railway staff failure has consistently increased over the last 5 years. Therefore, inter-departmental initiatives that reduce potential of human errors in IR system such as automated inspection & asset monitoring techniques, replacement of over-aged assets (tracks, signaling etc.) and up-gradation of asset maintenance infrastructure etc. needs priority emphasis.

3.20 The above insights would drive the basis for devising guiding principles for deploying RRSK funds. The desired outcome of this framework should be a clear perceptible improvement in safety across the railway system.

4. Mapping Sources of funds & expenditure of existing safety works

4.1 Having assessed various aspects of accidents, it is now important to map sources of funds and key areas of expenditures on railway safety works. As indicated earlier, investment on safety works is an ongoing process and MoR has been investing regularly to improve systemic safety in Railways. While the number of accidents that happen on Railways are still alarming, there has been a gradual decrease in both the number of accidents and number of casualties/injuries over the last five years (except 2014-15).

4.2 Coming to sources of expenditures first. Expenses for safety works are made both on Revenue account as well as Capital account. Revenue expenses primarily relate to expenditures incurred on repairs & maintenance of key assets such as Permanent-Way (P-Way comprising track infrastructure), Motive Power (locomotives, EMUs etc.), Carriages & Wagons (Coach, Wagons etc.) and Plant & Equipment. Similarly, Capital expenses primarily relate to capital activities involving creation or upgradation of assets such as Road Over Bridges (ROBs)/Road Under Bridges (RUBs), track renewals, bridge works, Overhauling rolling stock (POH/IOH) etc. There has been limited expenditure so far in acquiring state-of-the-art technologies for asset condition inspections and monitoring.

4.3 In terms of sources of funding, Revenue expenses are typically funded through IR's internal funds (own revenues). Capital expenses, on the other hand, are majorly funded through a combination of the following sources:

a) Gross Budgetary Support (GBS) from the Ministry of Finance;
b) Safety Fund (MoR's share of the cess on Petroleum fuel accruing to the Central Road Fund (CRF));
c) Depreciation Reserve Fund, DRF (primarily used for replacement of assets);
d) Development Fund (DF) (used for funding Railway capital works).

4.4 The table below shows item-wise sources of funds and sources of expenditures over the period 2012-13 to 2016-17(RE).

Table: Mapping Sources of funds and sources of expenditure on safety works (All figures in INR Crores)

Description	2012-13	2013-14	2014-15	2015-16	2016-17 RE	Sources prior to formation of RRSK
Revenue Expenditure (Gross) on Safety						
Repairs & Maintenance of P-Way	8234	9172	10282	10888	13539	IR's own revenues
Repairs & Maintenance of Motive Powers	3924	4465	4783	5273	6108	IR's own revenues
Repairs & Maintenance of Carriages & Wagons	9213	10331	11276	11952	14351	IR's own revenues
Repairs & Maintenance of Plant & Equipment	4805	5406	6027	6254	7832	IR's own revenues
Traffic Minor Head 600 - Safety	11	8	11	16	35	IR's own revenues
Total Revenue Account	**26187**	**29382**	**32379**	**34383**	**41865**	**IR's own revenues**
Capital Expenditure (Gross) on Safety						
Road Safety Works - Level Crossings	528	504	442	470	679	Safety Fund
Road Safety Works - ROBs/RUBs	1057	1482	1792	2133	9658	Safety Fund
Track Renewals	5426	4985	5372	5586	6740	DRF
Bridge Works	322	390	441	520	592	DRF + DF
S&T Works	939	905	1006	894	954	GBS+DRF+DF
Workshops (POH/IOH) of Rolling Stock	1324	1552	872	1530	2573	GBS+DRF+DF
Total Capital Account	**9596**	**9818**	**9925**	**11133**	**21196**	
Total (Rev + Capital)	**35783**	**39200**	**42304**	**45516**	**63061**	

Source: Railway Board, Ministry of Railways

4.5 The following important points are worth noting:

a) All revenue expenditures related to safety works are funded through IR's own revenues. This practice will continue even after formation of RRSK;

b) Prior to the creation of RRSK, Level Crossing (LC) related works were funded primarily through the MoR's share of the cess on Petroleum fuel accruing to the Central Road Fund. This was also in-line with the stipulations of the CRF Act 2000 that restricted deployment of CRF funds to other activities besides LC related works (Note the Finance Act 2016 has amended this stipulation, the impact of which has been discussed in later paragraphs);

c) Prior to the creation of RRSK, safety works besides LC related works, were funded through other Railway Capital Accounts such as DRF, DF and portion of GBS received from the Ministry of Finance.

4.6 Going forward RRSK is expected to become the primary funding source for safety works over the medium term. Existing sources such as DRF, DF etc. may continue funding the balance unmet requirements, subject to availability of funds.

5. Overview of RRSK – A safety fund with a broad mandate

5.1 As mentioned earlier, Rashtriya Rail Sanraksha Kosh (RRSK) has been created with a corpus of INR 1 lakh crores over a period of 5 years starting FY 2017-18. This implies a yearly funding of INR 20,000 crores till FY 2022-23. An amount of INR 20,000 crores has already been allocated to RRSK for FY 2017-18. The funding structure of RRSK is presented in the table below:

Table: RRSK Funding Structure (All amounts in INR Crores)

RRSK Structure (All amounts in INR Crores)	2017-18 BE
Budgetary Support from Ministry of Finance	5000
Transfer from DRF	4000
Transfer from Railway Safety Fund (MoR's share of CRF)	10000
MoR's Internal Sources	1000
Total	20000

Source: Budget 2017-18 documents

5.2 Further, the 2017-18 Budget documents also grants a broader mandate to the utility of RRSK. It states "*for capital expenditure on Railway safety works including the construction of over/under bridges on rail road crossings and erection of safety works at un-manned rail-road crossings, New Lines, Gauge Conversion and Electrification*". This means that RRSK can also be used for new lines, gauge conversion & electrification projects including the safety works related to level crossings, track related works, rolling stock works etc.

5.3 As mentioned earlier, the Finance Act 2016 amended Section 10 of the Central Road Fund Act 2000. The extract of this amendment[10] is reproduced here - "*fourteen per cent of the cess on high speed diesel and petrol for railways safety works, including the construction of road either under or over the railways by means of a bridge and erection of safety works at unmanned rail-road crossings, new lines, conversion of existing standard lines into gauge lines and electrification of rail lines: Provided that no repair,*

[10] Source: Item no. c, Part VII, Clause no. 230 of Finance Act 2016

maintenance or renovation work shall be carried out from the allocation of cess under this sub-clause;". This amendment also empowers MoR to utilize its share of CRF on other safety works besides those related to level crossings (construction of ROBs/RUBs etc.).

5.4 The net effect of the above two stipulations is that RRSK can be considered as a Safety Fund with a broader mandate to make the IR system fail safe. There are no notable restrictions or exclusions in its fund deployment options. Accordingly, all works specified in the document prepared by the inter-departmental Committee of ED's titled "Creation of RRSK for enhancement of safety of Indian Railway System" are technically eligible to be funded through RRSK.

5.5 Accordingly, the table below shows the BE outlays (from RRSK and other IR funds) for various Safety related Planheads.

Table: BE 2017-18 outlays across Safety Planheads and their sources of funding (All numbers in INR Crores)

Planhead (in INR Crores)	Funded from RRSK	Funded from other sources	Total Outlay	% Funding from RRSK
Traffic facilities - Yard remodelling & others	914	2171	3085	29.6%
Rolling Stock	1731	23463	25194	6.9%
Road Safety LC's	705	0	705	100.0%
Road Safety ROBs/RUBs	4512	1700	6212	72.6%
Track Renewals	9961	0	9961	100.0%
Bridge Works	738	0	738	100.0%
S&T Works	2247	83	2330	96.4%
Other Electrical Works	40	857	897	4.5%
Traction Distribution Works	501	40	541	92.6%
Machinery & Plant	300	350	650	46.2%
Workshops including PU's	400	2935	3335	12.0%
Training/HRD	70	55	125	56.0%
Credits/Recoveries	2119	NA	NA	NA
Total	20000		53774	37.2%

Source: Railway Board, Ministry of Railways

5.6 The above BE proposal shows the following:

a) For FY 2017-18, RRSK is being proposed to fund about 37% of safety works planned by MoR. The balance is being funded by other sources;

b) Key Engineering safety works (Track renewals and bridge works) are being funded completely through RRSK. Earlier, DRF was the main source of this funding. On the other hand, other funding sources have complemented RRSK in funding LC related works.

5.7 This implies that for safety works, fungibility in funding source exists. Therefore, while RRSK may not be sufficient to fund entire safety investment requirements of IR, it may still be feasible to identify sources to meet the balance requirements.

6. Safety Investment Projections – About INR 1,19,000 crores of works requested for funding through RRSK

6.1 As mentioned earlier, MoR had set an Inter-departmental Committee of senior officials in October 2015 to project investment requirements of safety works. With a final objective to achieve **Zero Accidents** in IR system, the committee outlined measures (department-wise works) requiring an overall investment of about INR 1,54,000 crores. Out of this, funding of around INR 1,19,000 crores was proposed to be met through RRSK. The balance (about INR 35,000 crores) was proposed to be met from IR's own sources. The table below shows the high-level department-wise safety investment requirements as projected by this committee (Source: Report of the inter-departmental committee dated December 2015).

Table: Overall Investment Projections for funding inter-departmental safety works (All amounts in INR Crores)

S. No.	Item	Anticipated outlay from DRF/SRF	Proposed outlay from RRSK	Total
1	Civil Engineering			
1.1	Track Renewal Works	20000	30032	50032
1.2	Bridge Rehabilitation Works	1750	3250	5000
1.3	Other Track Safety Works (Broken Rail Detection system, Isolation of tracks, Vehicular ultrasonic testing system etc.)		11697	11697
1.4	**Total Civil Engineering**	**21750**	**44979**	**66729**
2	Safety Works at Level Crossing (Elimination of LC, ROB/RUB etc.)	7500	43444	50944
3	S&T Works	5090	10140	15230
4	Rolling Stock related works		9263.55	9263.55
5	Electrical related works	500	9495	9995
6	Human Resource Development		1861.45	1861.45
7	**Total All Directorates**	**34840**	**119183**	**154023**

Source: MoR Inter-departmental committee report on "Creation of RRSK for enhancement of safety of Indian Railway System"

6.2 Item-wise break-up of proposals envisaged to be funded through RRSK (totaling INR 119183 crores) is reproduced below for additional reference. As can be seen, initiatives cutting across departments have been proposed below to achieve Zero Accidents.

Table: Item-wise details inter-departmental safety works proposed to be funded through RRSK (All amounts in INR Crores)

S. No.	Items / Work Proposals	Projected Requirements (INR Crores)
A.	**Civil Engineering**	
1	Track works	30032
2	Bridge rehabilitation	3250
3	Vehicular ultrasonic testing system for rail/welds	900

S. No.	Items / Work Proposals	Projected Requirements (INR Crores)
4	Provision for broken rail detection system	1624
5	Adoption of Flash butt welds and weld quality improvement	145
6	Measures of safety enhancement and improved maintenance	2915
7	Isolation of track from surrounding area	3995
8	Provision of Ballast less track at critical location	912
9	E-Monitoring of engineering assets for timely preventive action	200
10	Provision of diagnostic aids for bridges	381
11	Up-gradation and modernization of girder fabrication facilities	325
12	Arrangement for movement and unloading of P-way Materials	300
	Total Civil Engg	**44979**
B.	**Safety Works at Level Crossings** (Elimination of LC, ROB/RUB/Subways etc.)	**43444**
C.	**S&T Works**	
1	Train Protection warning system/Train collision avoidance system	2750
2	Up-gradation of standard of interlocking	1630
3	Replacement of overaged signaling gears at stations by electrical/electronic interlocking and in block sections	2540
4	Centralized on-line monitoring, predictive maintenance and event analysis	680
5	Provision of mobile train radio communication on A, B and C routes of IR	1800
6	Provision of OFC and Quad cables on IR	740
	Total S&T	**10140**
D.	**Mechanical Engineering**	
1	Freight Design and maintenance	2082
2	Coach design and maintenance	1014.05
3	Diesel locomotive maintenance, crew management and disaster management	6167.5
	Total Mechanical Engg.	**9263.55**
E.	**Electrical Engineering**	
1	Replacement of over aged Traction Distribution (TRD) assets	6500
2	Conversion of unregulated OHE to Regulated OHE	1125
3	Replacement of masts/Portals having critical implantations	425
4	Replacement of old and over-aged transformer, cables, earthing, panels, wiring etc. for operating installations	300
5	Audio/Video Recordings in loco cabs of all electric locos	210
6	Automatic Wheel Profile Monitoring System	500
7	Crew Friendly cab with air conditioning	435
	Total Electrical Engg.	**9495**
F.	**Human Resource Development**	**1861.44**
G.	**GRAND TOTAL**	**119183**

Source: MoR Inter-departmental committee report on "Creation of RRSK for enhancement of safety of Indian Railway System"

6.3 Compared to the requested funding of INR 1,19,183 crores as above, RRSK has a corpus of INR 1,00,000 crores. Clearly, all safety works requested by MoR cannot be funded through RRSK. The difficulty increases if one compares overall requirements of INR 1,54,000 crores vis-à-vis the RRSK fund corpus. Given this practical constraint, prioritization of safety works is unavoidable. Hence, MoR will necessarily need to complement funds from other sources (Extra Budgetary, PPPs, DRF, DF or other innovative means) to finance the balance un-funded safety program. **With this, the next section discusses the recommended framework for prioritization of Safety Works.**

7. RRSK Fund Deployment Framework

7.1 The objective of this section is to suggest a suitable framework MoR may consider for deploying RRSK funds. The framework essentially enumerates guiding principles which may be used for deciding works which need to be funded through RRSK on a priority basis. This is not to say that other safety works are not as important. As mentioned earlier as well, safety is a holistic subject and it requires a multi-disciplinary effort to make the system fail safe. Efforts of all Railway directorates are therefore equally important and equally critical. However, as funds are a constraint, it is not possible to fund every safety work through RRSK. The Government would need to tap into other sources to fund works that can't be funded through the same.

Framework Objective

7.2 Before proposing a framework to deploy RRSK funds, it is important to define the end goals/objectives targeted to be met through this fund. Ideally, the objective should be Zero Accidents and resultantly Zero accident related casualties or injuries. But this may be ambitious given the existing complexities of railway operations. Therefore, a more realistic objective is to minimize number of accidents and thereby create an environment where casualties, injuries or any loss to property is minimized. Such a situation would lead to a "*perceptible improvement in safety scenario over Indian Railways"* – as desired by MoR. Keeping this objective in mind, the paragraphs below discuss the recommended fund deployment framework.

Recommended Principles for prioritization

7.3 Identifying a range of inter-departmental safety initiatives, the committee of senior MoR officials projected funding need of about INR 1,19,183 crores from RRSK. Against this, the approved RRSK corpus is INR 1,00,000 crores. Clearly, everything cannot be funded through RRSK. Given this practical constraint, prioritization of safety works is unavoidable. Accordingly, the paragraphs below aim to outline the principles for prioritizing safety works.

7.4 The section on "Assessment of Accidents" brought out key insights pertaining to areas which require immediate and urgent attention for safety enhancement. The important findings are re-produced below for reference (Reference period of data assessments: 5 years from 2012-13 to 2016-17):

a) Together, Derailments and LC related accidents accounted for 90% of total accidents, 85% casualties and 82% injuries on IR networks. What this means is that initiatives for reducing/eliminating Derailments and Level Crossing accidents need to be accorded highest priority;

b) The next question to examine is which directorates/stakeholders account for the above accidents? Engineering, Mechanical, Electrical and Other than Railway Staff (primarily road-users) are responsible for 83% of all accidents. Out of this, Civil Engineering and Other than Railway Staff account for 67% of accidents. Meaning most derailments and LC accidents are accounted by these stakeholders. On a y-o-y basis, there has been a 60% increase in the number of accidents for which Civil Engineering Directorate was responsible. With such **disproportionate contribution** to accidents and deterioration of y-o-y record, there is clearly a strong case for ensuring highest priority to Civil Engineering works.

   This implies that, besides works for reducing/eliminating LC accidents, works undertaken by Civil Engineering, in particular, and other directorates - Mechanical and Electrical that lead to reduction/elimination of derailments need to be targeted on priority.

c) Human failures contribute to about 87% of all accidents. 46% of these are a result of railway staff failure and 41% failure of non-railway (road users). What this means that derailments/LC take place in the first place because people fail to respond or correct themselves appropriately. Hence, initiatives that eliminate opportunities of relying *primarily* on people need priority emphasis. This could be combination of works such as automated inspection & asset monitoring techniques, replacement of over-aged assets (tracks, signaling etc.), eliminating un-manned level crossings and up-grading asset maintenance infrastructure etc.

d) The interesting thing to note is that there is no contradiction in observations above. Take derailment for instance. Derailment happens due to infirmity in rail track or wheels. There could be various ways through which this can happen. Reliance on human inspection can create chances where gangmen may have failed to point out a crack or defect in rail. Similarly, delays in renewing tracks overdue for replacement may create opportunities where rail may fail. Inability to monitor condition of wheels (profile etc.) on a real time basis may create opportunities where train may derail due to wheel defect. So it's a complex combination of directorates (Engineering, Mechanical/Electrical) as well as human failure that "causes" derailment. Hence the observations in a), b) and c) above are completely consistent with each other.

e) To conclude, minimizing/eliminating derailments and LC related accidents is the clear priority. All LC related works need to be funded adequately. For derailments, inter-departmental initiatives and those of Civil Engineering in particular need to be funded. Without the above priorities, achieving a perceptible improvement in railway safety may be unlikely.

7.5 Given the above findings and considering the end objective of minimizing accidents and thereby loss of lives and property, the following principles are recommended for funding prioritization:

a) **Priority 1:** Overall, the case for prioritizing Civil Engineering Works (for minimizing derailments) and LC related works is **strongly evident**. Therefore, it is suggested that RRSK should ensure that most requirements of Civil Engineering works and LC related works are met. So, in this sense, these areas are suggested to have the first charge on RRSK;

b) **Priority 2:** The second charge on RRSK is suggested to be of those works/initiatives of Electrical and Mechanical Engineering Directorates which target derailments. Such works may, for example, include up-grading rolling stock maintenance infrastructure, technologies to monitor wheel profile, cracks, broken parts, adopting coaches with improved safety features (LHB, ICF coaches with CBC) etc.

c) **Priority 3:** Finally, balance RRSK funds are suggested to be deployed on works/initiatives which target reducing chances of human errors in critical areas of operations. Such initiatives may include investments on improving working conditions and training of safety critical staff such as loco-pilots, strengthening signaling systems to avoid instances of SPAD, using technology to monitor health of tracks/wheels/rolling stock components relevant for wheel track interactions etc.

d) It may be noted that there may be overlaps in the above prioritization principles. For example, technologies such as broken rail detection system and vehicular ultrasonic testing systems may not only be treated as Priority 1 items (civil engineering works), but they may also be treated as Priority 3 items (reducing chances of human error in inspecting integrity of tracks). For all such cases, it is suggested that MoR may take a judicious call given their in-depth understanding of technical aspects of railway safety. While doing so, MoR may give due consideration to the underlying intent of prioritization, which is to eliminate instances of derailments and LC accidents.

7.6 These prioritization principles are also consistent with the overall safety vision articulated by MoR recently. As part of its vision[11], MoR has committed achieving a safe and secure railway operating environment leading to "Near Zero Fatalities" within a time bound manner. Some key thematic targets include: a) Eliminating all Unmanned Level Crossings (UMLC's) on Broad Gauge (BG) network by 2020; ii) Upgrading rolling stock; and iii) Accelerating renewal of overdue tracks and ensure absence of backlogs in future.

Suggested RRSK Deployment Scheme

7.7 Basis the above prioritization principles and in-sync with the Safety Vision of MoR, an attempt has been made to suggest a RRSK deployment mix. It may be noted here that this deployment mix is *indicative* as there are areas where MoR may need to do more assessments. For example, it is suggested that funding for Engineering Works should first be undertaken on Classes A (High Density Networks), B, C, D and D Special. Any savings on account of not undertaking works of other route classes should be diverted to Priority 2 and 3. Further, the obvious underlying assumption is that only Capital Works are to be covered. Revenue works are not proposed to be funded through RRSK.

[11] Source: Indian Railways – Vision and Plans 2017-19 released by MoR in January 2017

Table: Recommended RRSK deployment scheme (Over a 5-year period)

Directorate	Funding Requested from RRSK (INR Crores)	Recommended Funding (INR Crores)	Priority	Remarks
LC Related Works**	43444**	43444**	1	Understand this is MoR's share. Recommend if MoR's share can be brought down through innovative models like State Govt. funding, PPPs or Ministry of Road Transport & Highways (MoRTH) funding
Civil Engineering Works	44979	44979	1	Recommend works on A, B, C, D and D Special routes be done first and savings on non-priority routes, if any, should be passed on to other unfunded works under Priority 2 and 3 below
Electrical + Mechanical	18758.55	11577	2 and 3	Recommend works that target eliminating/minimizing derailments and improve conditions of safety critical staff such as loco-pilots. MoR may request each directorate to delineate those works appropriately. Examples include up-grading rolling stock maintenance infrastructure, technologies to monitor wheel profile, wheel defects, broken parts, adopting coaches with improved safety features, crew-friendly cabs, audio-video recording in cabs etc.
S&T	10140			Recommend works that target eliminating/minimizing derailments such as technologies for eliminating SPAD instances etc.
HRD	1861.45			Recommend investment on training staff to adopt and understand technologies to eliminate opportunities of human errors.
Total	**119183**	**100000**		Recommend balance unmet requirements to be funded from other IR sources including innovative funding from EBR, PPPs etc.

Source: Internal Analysis

7.8 **A caution on the recommended RRSK fund deployment for LC works is warranted here. As per the extant policy guidelines, the costs for undertaking LC works (ROB/RUB construction etc.) are shared between MoR and State Governments or for some cases Ministry of Road Transport and Highways (MoRTH) as well. Some relevant principles[12] of this cost-sharing framework are re-produced below:

[12] Source: Relevant extracts from "Policy Issues related to Level Crossings and ROBs/RUBs No. 2007/CE I/LX/90" as received from the Ministry of Railways

a) *ROB/RUB works are undertaken by Railways in lieu of existing level crossings on cost sharing basis if the traffic density at the level crossing is one lakh or more Total Vehicular Units (TVUs) (TVU- a unit obtained by multiplying the number of trains to the number of road vehicles passing over the level crossing in 24 hours) otherwise on 'Deposit Terms' basis. Cost of Land is borne by State Government. Construction of ROB/RUBs in lieu of existing level crossings which have traffic density of less than 1 lakh TVUs is considered on 'Deposit' Terms, proposal for which is sponsored by concerned State Govt. duly agreeing to bear the entire cost of construction and recurring maintenance charges thereof. Similarly ROBs at new places where no level crossing exists' are also provided on 'Deposit' Terms.*

b) *Railways share 50% cost of the total work for a two lane Road Over Bridge i.e. 7.5 meter wide carriage way with 2 footpath of 1.5 meter width on either side.*

c) *Railways share 50% cost of 4 lane ROB/RUB provided minimum TVU of the level crossing is 3 lakhs comprising not less than 6000 road vehicle units.*

7.9 Hence, for most of the LC works, Railways bears only a proportion of total costs (and not the entire). Rest of the cost is borne by State Government. The problem with such arrangement is that, despite MoR deploying its share through RRSK, LC works cannot be completed till the balance funding is not made available by State Governments. To elaborate this further, assume a ROB costing say INR 50 crore is to be constructed to eliminate an LC. Even if MoR funds INR 25 crore for this work through RRSK, the work can't be completed till the concerned State Government releases the balance amount. Therefore it is recommended that RRSK funds should not be deployed for those LC works where contribution from States/other authorities is not available. Savings on account of non-deployment of such funds should be allocated instead to derailment related projects of other directorates (Electrical, Mechanical, S&T etc.). This approach will ensure that RRSK funds are deployed efficiently and effectively without getting locked up on projects that can't be implemented in a timely manner.

7.10 Finally, it is again re-iterated that an unbiased independent attempt has been made to devise RRSK deployment scheme. This is based on an objective analysis of accident related data and is *open to further review and wider debate*. Ample *flexibility* has been proposed where MoR can deploy savings from expenditure on Priority 1 areas to other areas. For example, savings on account of engineering works on routes other than A to D Special class, can be utilized on Priority 2 and Priority 3 areas. Further, opportunities also exist particularly on LC related expenses where MoR share could come down through collaboration and additional support from other agencies (PPPs, MoRTH, etc.).

7.11 However, Accidents happen due to complex factors and hence it is important to implement other initiatives, as well, that could not be funded through RRSK. Despite not having a dedicated safety fund in the past, safety plan-head funding pattern earlier showed that MoR has been able to find appropriate funds in the past. It is hoped that the same pattern continues in future for unfunded works.

8. Other related suggestions

8.1 Taking a step back, the end goal of setting up RRSK in the first place is to create an environment where no accidents happen. That would mean zero casualties or injuries or loss to property. Deploying RRSK funds is a crucial means to achieve this. But it would defeat the purpose if funding does not make the desired impact. It is therefore suggested

that RRSK outlays are linked to specific outcomes which are measurable and can be monitored from time to time. This would require the respective directorates to design outcomes against initiatives being funded from RRSK. Some suggestions are given below. It is also recommended that the Railway Board devises a strategy to take course-correction measures in case fund deployment does not lead to clear measurable improvement in railway safety.

Table: Suggestions for linking RRSK outlays to Safety Outcomes

Directorates	Suggested Outcomes for measuring impact of RRSK Outlays
Civil Engineering	• % reduction in rail fractures/defects (measuring impact of track renewals) • % increase in fractures/defects detected through USFD/Broken rail technology (measuring impact of using new inspection technologies) • Reduction in derailments accidents on routes where investments made (Overall investment impact)
Mechanical & Electrical	• % reduction in accidents attributed to these directorates • % increase in wheel failures detected through new technology
Overall	• % reduction in LC accidents and derailments • % reduction in casualties or injuries related to LC and derailments

8.2 The second related suggestion to improve overall safety situation is to consider a paradigm shift in the way safety is operationalized in IR institution. The HLSRC Committee headed by Dr. Kakodkar had recommended creation of a new statutory outfit "Railway Safety Authority". The Committee had proposed various details related to the same – its organizational structure, scope and powers, statutory position, linkages with the Railway Board and the Ministry, functions etc. This is broadly in line with global best practices[13] where railway systems prepare a systematic analysis of the safety risks faced and the set of measures needed to mitigate the risks. The independent safety authority reviews and approves the safety case and oversees its implementation.

8.3 It is therefore suggested that MoR considers appropriate changes in the way safety organization is structured and dealt with in its institution currently.

8.4 Finally, it is also suggested that MoR considers relooking/redesigning existing Railway timetable. Several High Density Network (HDN) sections in IR network operate with capacity utilization greater than 120% (even up to 150% and beyond for some). One of the key reasons for this is mixed traffic that runs on the railway network. Mail/Express/Rajdhani/Shatabdi, Ordinary passenger trains, goods trains all ply on the same route with different speeds and priorities. Majority trains that carry passengers do not run to optimal capacities thereby choking the available network. For example, some trains may run with configuration of 12 coaches, others with 14, 16, 18 and so on. This issue is further aggravated as slow ordinary passenger trains often stop at a large number of stations thereby clogging entire network. Such heavy capacity utilization poses significant risk to Railway safety as undertaking track maintenance or inspection activities becomes difficult on a daily basis.

[13] Source of these inputs: World Bank Team comprising Ms. Martha Lawrence, Mr. Benedict Eijbergen, Karla Carvajal and Mr. Atul Agarwal

8.5 Hence redesigning Railway timetable in a manner that sufficient margin is available for safety checks is imperative. Ongoing network decongestion and expansion projects on HDN routs (doubling, tripling, quadrupling, DFCC etc.) would surely give above safety margins. However, till the time these projects are being commissioned, MoR may consider rationalizing trains (by combining few trains; increasing coaches or wagons, rationalizing stops) as an alternate approach.

9. Conclusion

9.1 MoR had set an Inter-departmental Committee in October 2015 of senior officials to project investment requirements for executing safety works. With a final objective to achieve **Zero Accidents** in IR system, the committee outlined measures requiring an overall investment of about INR 1,54,000 crores. Out of this, funding of around INR 1,19,000 crores was proposed to be met through a new dedicated Railway Safety Fund called "Rashtriya Rail Sanraksha Kosh" ("RRSK"). The balance (about INR 35,000 crores) was proposed to be met from IR's own sources. Pursuant to discussions between the Railway Minister and the Finance Minister, RRSK was announced in 2017-18 Budget speech with a corpus of INR 1 lakh crore over a period of 5 years.

9.2 Clearly, all safety works cannot be funded through RRSK. Given this practical constraint, prioritization of safety works is unavoidable. Objective analysis of data related to railway accidents over the last 5 years (2012-13 to 2016-17) throws the following crucial observations:

a) Together, Derailments and LC related accidents accounted for 90% of total accidents, 85% casualties and 82% injuries on IR networks;

b) Engineering, Mechanical, Electrical and Other than Railway Staff (primarily road-users) are responsible for 83% of all accidents. Out of this, Civil Engineering and Other than Railway Staff account for 67% of accidents. On a y-o-y basis, there has been a 60% increase in the number of accidents for which Civil Engineering Directorate was responsible.

c) Human failures contribute to about 87% of all accidents. 46% of these are a result of railway staff failure and 41% failure of non-railway (road users).

9.3 The above observations clearly mean that initiatives for reducing/eliminating Derailments and Level Crossing accidents need to be accorded highest priority. While there are identified works to eliminate LC accidents (constructing ROBs/RUBs etc.), eliminating derailments requires inter-departmental action. There is a strong case to adequately fund Civil Engineering works first given the observations above and given its disproportionate contribution to accidents. Hence, in this regard, Civil Engineering Department works are recommended to have the first charge/priority on RRSK.

9.4 Civil works need then to be complemented by works of the following directorates - Mechanical and Electrical that target reduction/elimination of derailments. Initiatives of other directorates (S&T, HRD etc.) which target reducing chances of human errors in critical areas of operations are recommended to have the third charge/priority.

9.5 Basis the above principles, a suggested RRSK deployment scheme has been developed. The same is re-produced below for **review and further debate**:

Table: Recommended RRSK deployment scheme (Over a 5-year period)

Directorate	Funding Requested from RRSK (INR Crores)	Recommended Funding (INR Crores)	Priority	Remarks
LC Related** Works	43444	43444	1	Understand this is MoR's share. Recommend if MoR's share can be brought down through innovative models like State Govt. funding, PPPs or MoRTH funding
Civil Engineering Works	44979	44979	1	Recommend works on A, B, C, D and D Special routes be done first and savings on non-priority routes, if any, should be passed on to other unfunded works under Priority 2 and 3 below
Electrical + Mechanical	18758.55	11577	2 and 3	Recommend works that target eliminating/minimizing derailments and improve conditions of safety critical staff such as loco-pilots. MoR may request each directorate to delineate those works appropriately. Examples include up-grading rolling stock maintenance infrastructure, technologies to monitor wheel profile, wheel defects, broken parts, adopting coaches with improved safety features, crew-friendly cabs, audio-video recording in cabs etc.
S&T	10140			Recommend works that target eliminating/minimizing derailments such as technologies for eliminating SPAD instances etc.
HRD	1861.45			Recommend investment on training staff to adopt and understand technologies to eliminate opportunities of human errors.
Total	**119183**	**100000**		Recommend balance unmet requirements to be funded from other IR sources including innovative funding from EBR, PPPs etc.

** *Recommend RRSK funds to be not deployed for those LC works where contribution from States/other authorities is not available. Savings on this account should be re-appropriated to works of other directorates (Mechanical, Electrical, S&T etc.) targeting derailment.*

9.6 It is also suggested that RRSK outlays are linked to specific outcomes which are measurable and can be monitored from time to time. This would require the respective directorates to design outcomes against initiatives being funded from RRSK. This would also enable Railway Board to take course-correction measures in case fund deployment does not lead to clear measurable improvement in railway safety.

9.7 Another related suggestion to improve overall safety situation relates to setting up a new statutory independent outfit "Railway Safety Authority". This suggestion has already been recommended by the HLSRC headed by Dr. Kakodkar. This is broadly in line with global best practices where railway systems prepare systematic analysis of the safety risks faced and the set of measures needed to mitigate the risks. The independent safety authority reviews and approves the safety case and oversees its implementation. Finally, it is suggested that MoR considers relooking/redesigning existing Railway timetable. Timetable should be redesigned in a manner that sufficient margin is available for daily safety checks.

9.8 Ensuring safety in railways is an absolute imperative for the Government. Together, all the above measures are expected to significantly enhance safety in railways. Implemented efficiently, these suggestions have the potential to structurally transform the safety situation thereby enabling MoR realize its vision of "Near Zero Fatalities" in the next few years.