An analysis of performance of Indian railways

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Abstract: Indian railways (IR) considered as the lifeline of India, connects the second most populous country's every nook and corner. The logistical and financial performance of the biggest logistics carrier has been at a low ebb for a couple of years. The gradual deteriorating health of IR not only captivates the attention but also sets in disquietude in mind to fathom the inherent causes of this fragility. During the last couple of years, the worrisome performance of IR has grabbed literature positioning in galore but they are devoid of satisfactory diagnosis of the maladies. Against this background, an analysis of the deteriorating performance to find the inherent reasons is inevitable. The study employs several measures such as OR, COR, and ROLAR, etc. for the purpose of analysis. IR is abysmally afflicted with unsatisfactory OR, COR, and ROLAR and is on the verge of financial collapse. It ought to do away with subventions such as subsidies henceforth, put an end to archaic pricing policies and adopt what the traffic can bear pricing strategy lest it collapses and paralyses.

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1 Introduction

Indian Railways (IR), owned and operated by the Government of India, is the world's third-largest transportation and logistics network (India Brand Equity Foundation, 2019). As per Facts and Figures of IR (2016–2017), the biggest government undertaking has an extensive network of more than 7,300 stations sprawled over 70,000 km of track and manned by over 1.4 million employees. It runs more or less 14,000 passenger trains and 10,000 freight trains daily (Indian Railways, 2016-17, Saluja, 2020). It is a matter of great concern that even after the passage of more than six decades of much sought after independence, only 60% of the network is electrified (Business Wire, 2020). The expansive network, complex blend of functions, and matrix nature of the organisation cause IR to be managed in a multi-layer system with the whole of IR divided into zones and zones into divisions (George and Rangraj, 2008). At present, there are 16 zones, excluding Kolkata Metro, and 73 divisions (Indian Railways, 2018; Ranjan et al., 2016).

The primary activities of 'the lifeline of transportation of India' are chiefly divided into passenger and freight services (Choubey, 2020). The importance of IR increases further because it is also related to shipping and shipping is closely related to trade volume. During the financial year 2018–2019, it carried 8.35 billion passengers and 1.22 billion tonnes of freight (Budget, 2019-20). The total revenue of IR in Indian Rupees was 1.96 trillion whereas the total expenditure stood at 1.91 trillion, resulting in an abysmal net revenue of 60.14 billion and an operating ratio (OR) of 96.2% during the same period mentioned above. During 2018–2019, the freight business contributed more than 60% of the total earnings of IR, followed by the passenger, sundry, and coaching segments respectively (Statista, 2020). As per the IBEF (2019) report, gross revenue of IR has been registering a compound annual growth rate (CAGR) of 6.2% since 2008. During the period mentioned, the CAGR in earnings from the passenger segment was 6.43%, whereas the same from the freight segment stood at 4.03%.

According to the reports of the Comptroller and Auditor General of India, there are three avenues of resources for IR, namely:

1   internal resources

2   extra-budgetary resources

3   gross budgetary support.

Internal resources include revenue from passenger traffic, goods traffic, sundry earnings, and other coaching earnings. Extra-budgetary resources include borrowing through the Indian Railway Finance Corporation (IRFC), institutional finance through the Life Insurance Corporation of India, and investment through public-private partnerships. The CAG of India (2019) states that out of the total revenue of IR during the period 2012–2017, the contribution of earnings from freight traffic was more than 46% (maximum), followed by passenger earnings (18.7%), budgetary support (14.3%), extra budgetary resources (12.7%), other revenue earnings (6.09%), and diesel Cess (1.59%). Freight earnings are the backbone of IR because a large chunk of passenger earnings go to concessions given to a variety of passengers, and IR has to fall back upon freight earnings for meeting expenses (PRS, 2020). The consistent losing of freight share to road transport for one reason or the other is a matter of grave concern for IR. The same concern was emphasised by Narayanaswami (2018) and Business Line (2019). They pointed out that sinewed IR has started to bear the brunt of competition from other forms of transport, such as roadways and airways. Though IR enjoyed a monopoly position until very recently (Anu, 2017; Nandi, 2020), it needs restructuring lest the condition should aggravate further.

Despite the financial crunch (Nag, 2019; Dash, 2019), IR has maintained, though not very perceptible and impressive, an increment in network, number of trains, and IT-enabled services (Sharma, 2019). In today's highly competitive environment, managing logistics functions is a key determinant of overall business performance (Awasthi et al., 2018; Gunasekaran and Ngai, 2003). Nevertheless, IR is mandated to perform efficient and effective movement of passengers and freight with safety and security as a priority (Indian Railways, 2011), the growing consumerism and user-friendly services provided by other modes of transport at competitive prices are adding to the woes of this gigantic carrier (Choudhury, 2017; Naidu and Shyam, 2018), which already seems afflicted with a cash crunch and below-expectation performance.

Tiwari and Tiwari (2020) rightly point out that rapid changes in the taste of customers, enhanced level of competition, and stringent regulatory norms force organisations to adopt suitable strategies to survive, and this applies to IR also. The importance of robust surplus revenue is quite vivid for the expansion and modernisation of an organisation (Sriraman, 2000). Paltry or deficit surplus may prove a death knell for any business. The IR has been consistently afflicted with paltry surplus and the condition, especially on the financial front, has been deteriorating over the years (Das, 2019). Why? Is it that IR does not follow advanced planning system properly? APS is used for optimal operations in various areas of an organisation, such as logistics, production, and scheduling (Vidoni et al., 2020). The views of Raghavan (2016) can be paraphrased in such a way that the history long subsidisation of IR services is supposed to be proving a nail in the coffin.

The consistent lackadaisical performance of IR raises many questions. Does IR suffer from a bad OR? If so, what are the reasons? Is there any sufficient funds left with IR for expansion and modernisation? If so, why is the pace of expansion and modernisation, including electrification, so slow? Such questions become more pertinent at a time when it is not enough for an organisation to be efficient or effective, but to be innovative to offer competitive advantage (Ipinazar et al., 2021; Rosberg et al., 2021). It is well-acknowledged that transportation networks are the life and soul of modern societies as they not only ensure the well-being of individuals but also foster economic growth (Muriel-Villegas and Correa-Espinal, 2019). What to talk of efficiency or effectiveness? Even after 167 years of the launch of railways in India and 72 years of Independence, only around 60% of rail-track is electrified. Is IR not efficient in the provision of logistical services? Does IR get sufficient profit out of the logistical assets employed? If so, why does IR have to rely on compensation to feed the revenue deficit? Does IR meet the Corporate Safety objectives as enshrined in Chapter-II of IR? If yes? Why is IR criticised in matters of quality, including safety, and so on? To find out the lacklustre performance of IR and answer these plethora's of questions, IR needs to be analysed from several angles. The present study will encompass chiefly productivity and safety dimensions to know the inherent reasons of below-expectation performance, and thereby, employs LSCR, COR, ROLAR, etc.

2   Review of the past researches

A thorough look-up of the available literature on IR resulted in the accumulation of some helpful studies. One of the studies was done by George and Rangaraj (2008), who did a benchmarking study of the zones of IR in pursuit of developing an alternative approach to measure the performance of IR from the perspective of the supply chain. They employed data envelopment analysis for the purpose of the performance appraisal. The study finds that the performance of the central and western zones is excellent, whereas other zones, including the east coast, north central, and south east central, have also performed satisfactorily, though not at par with the central and western zones. The conditions of some of the rest zones, including been fragile. However, the authors find that there eastern, north east frontier; northern, southern, and south central, have is much scope for improvement in their efficiency. However, the statements of Gupta and Sathye (2008) in their study on 'Financial turnaround of the Indian railways: a case study' seem not to be in conformity with the findings of George and Rangaraj (2008), who state that the performance of IR is not up to the mark. However, here one point has to be kept in mind

that the study of George and Rangaraj (2008) is zone-wise whereas the study of Gupta and Sathye (2008) is IR as a whole. Gupta and Sathye (2008) state that IR has seen a transition from a low-performing organisation to a high-performing one, and attribute this change to strong management from the then Railway Minister, Nitish Kumar. According to the authors, under the helm of Nitish Kumar, the IR has seen the end of bureaucratic hurdles and the politicisation of decision-making. In addition to them, some of the key strategies adopted by the then IR minister brought about a perceptible change. For instance, the retrenchment strategy helped reduce operating costs, the pricing strategy resulted in an increase in revenues, and the reorganisation strategy helped IR achieve efficiency. All of these factors changed the very fate of IR and it saw the turnaround in its state. The findings of Alivelu (2010) are in consonance with the findings of Gupta and Sathye (2008).

Deshpande and Weisskopf (2010) undertook a study to find out whether the long-running policies of reservation are negatively affecting the productivity of IR. Though the inefficiency argument is often put forward whenever there is a case of reservation in an organisation (Thorat et al., 2016), the findings of Deshpande and Weisskopf (2010) negate the prejudice against reservations in IR and defy the claims that representation of a marginalised section of society in IR comes at the cost of productivity and efficiency. Contrary to the ingrained mindset that affirmative action in IR recruitment has brought about inefficiency in the system of IR, the authors find that the opposite is true in the case of IR, and the same was buttressed at other places in the work of Deshpande and Weisskopf (2014, 2016). As Gunasekaran et al. (2000) assert, the proper management of people in an organisation is an important issue for productivity improvement, the inclusion of backward classes in the functioning of IR is likely to bring in efficiency and productivity. Nandan (2010) has tried to measure the performance of IR from the marketing point of view. The author has taken into account the service quality of IR at platforms, and studied behavioural factors and servicescape which govern the performance of IR. Ghosh et al. (2012) shed light on the causes of the increase in the number of accidents in IR. The authors find that new train-routes are nominal, and have not been increased as compared to the growth in the number of trains. This has resulted in acute congestion and over-utilisation of the old tracks. The authors further state that the present infrastructure is inefficient to cope with the increase in traffic-flow, and will lead to scheduling problems. Lack of proper information sharing is also one of the reasons behind this. Kumar et al. (2018) have rightly stated that information sharing on time is imperative for the improvement of the transport industry. All of them combined bring about accidents such as derailment and collisions. Such problems are chiefly afflicting the western and central parts of India. The author suggests the speedy construction of new tracks, keeping in mind the phenomenal growth in the number of passengers, trains, and vocal demand for connectivity in the fast-progressing country. Nag (2013a) has examined the procedures and mechanisms of IR with regard to procurement of inputs, including methodology, organisation structure, and their impact on efficiency and accountability. The author finds that factors affecting a strong procurement process, such as transparency, value for money, fairness, and quality are wanted in the case of IR, and thus, internal vigil and external oversight by independent auditors and bodies are expected to change the scenario.

Nag (2013b), in another research paper, has compared the efficiency of IR with the world railways by employing the data envelopment analysis (DEA) technique. The DEA

is of greater significance and other researchers, such as Agrawal (2020), Cullinane et al. (2017), Hassan and Oukil (2021), Khan and Shireen (2020), Khan and Gulati (2021), Rahimi et al. (2020) have also used this in their analyses. Nag (2013b) states that the performance of IR has been on the up and up over the years. IR is one of the best performing railways in the world; the others are Japan Railways, Chinese Railways, Russian Federation Railroads, USA Railroads, and Italy FS Spa. The author further states that the North Central Railway, Central Railway, and East Coast Railway of IR are the most efficient ones. The findings of Nag (2013b) are in conformity with the findings of George and Rangaraj (2008), who also found that the performance of the Central and Western zones is excellent, whereas other zones, including the East Coast, North Central, and South East Central, have also performed satisfactorily. Ramaraju (2013) in its study on the operational efficiency of IR has brought to light some constraints which are hampering the efficiency of IR. The author finds that IR suffers from capacity constraints and these are afflicting chiefly the high density-routes such as Delhi-Mumbai, Delhi-Howrah, Howrah-Chennai, Delhi-Chennai, Mumbai-Chennai, etc. It was further found that these routes carry more or less 60% of the traffic while they represent only 20% of the IR total network. The other 80% of the IR network carries only 40% of the traffic. Gunasekaran et al. (2004) have rightly asserted that capacity determines the level of activities. Appropriate capacity utilisation is a must for targeted efficiency and productivity. Therefore, Ramaraju (2013) suggests doubling of lines, network expansion, and electrification. These measures will indubitably enhance the operational efficiency of IR.

Bhanot and Singh (2014) studied the performance of the container business of IR using DEA. They claim that efficiency with CONCOR has fluctuated between 87.5% and 100%. The reasons for such fluctuations, as per the authors, are the haphazard usage of infrastructure, such as the number of terminals and the number of yard equipment, without giving attention to the actual requirements. The authors suggest that norms should be formulated to enhance efficiency. Deshpande and Weisskopf (2014) have checked whether affirmative action reduces the productivity and efficiency of IR. They have found that there is no evidence to vouch for the claims that affirmative action is hampering the productivity of IR. In stark contrast to the held-views, the authors claim that more representation of people from backward classes in higher-level jobs at IR is likely to enhance the productivity and efficiency of IR. The authors cite the reasons behind the probable improvement in efficiency. They point out that, since people from the backward classes have been suffering from subjugation and marginalisation, they are highly motivated to perform to the best of their abilities and leave no stone unturned to defy the popularly held belief that people from the backward classes are not competent to perform at par with others. This synergy brings more productivity and enhanced efficiency in the functioning of the IR if they are given more representation at high places in the IR.

Gupta et al. (2015) analysed the public procurement environment in IR. The authors argue that supplier relationships with IR are not up-to-mark, resulting in inefficiencies such as high lead time, high cycle time, a costly and time-consuming supplier selection process, lack of accountability, blurred responsibility, etc. The entire procurement mechanism is not based on a long-term strategic approach. The IR need to adopt lean

logistics, as Sopadang and Wichaisri (2021) rightly emphasise, adoption of lean logistics is imperative for improving the organisation for sustainability business. The findings of Gupta et al. (2015) are in consonance with and complement the findings of Nag (2013a). Sharma et al. (2016) studied the performance of IR from the marketing point of view. They have analysed various parameters of service quality, such as punctuality, safety and security, and public complaints by adopting DEA. The study encompasses all zones of IR, and the parameters of inputs used in the study are the number of employees, working expenses, and equated track kilometres. The output parameters used in the study are passenger traffic kilometres, punctuality, revenue, and public complaints. The study claims that there is redundancy and non-optimum use of resources, over deployment of a huge work force to inefficient zones. The authors suggest that IR should adopt the DEA methodology to assess and improve the performance of the zone. Ranjan et al. (2016) analysed the effect the various evaluation criteria have on the performance of IR. For this purpose, they used DEMATEL and VIKOR methods, which take into account a combined multi-criteria decision-making approach. They assert that route distance is a big factor that plays a great role in the evaluation of the performance of IR, and it affects other criteria as well. According to Ranjan et al. (2016), 'the VIKOR method aggregates the performance score under different criteria into an overall performance value for each railway zone'. They suggest that IR should develop the requisite infrastructure to improve the satisfaction level of customers.

Vaidya (2018) proposed an approach for 'on-time' performance appraisal of IR. The approach which the author used in the study is based on six-sigma computation. Six Sigma is applied to 'improve process effectiveness' (Adeodu et al., 2021). The proposed approach to performance appraisal goes far beyond the conventional DMPO approach and has been validated by using various data sets. This is an extension to the existing sigma computation and can compute the sigma level for any unruly data as well. Anand and Gupta (2018) in their case study of the productivity of IR with special reference to New Delhi Railway Station, find that the handling capacity of passengers at railway stations is poorer than in European countries. The stations are incapable of using the land resources to their fullest capacity, and buildings are under-utilised too. The stations suffer from some additional problems, such as the lack of hold-up areas for crowd management and the lack of proper guidelines for passengers regarding the carriage of belongings. All of these factors hamper the proper functioning of IR and thus reduce productivity and efficiency.

Bhatia and Sharma (2021) conducted a study on 'Expense-based performance analysis and resource rationalisation: case of Indian railways' to assess the efficiency rating of each zone of IR and find out the benchmarking zones for the purpose of facilitating the inefficient zones to the high-performance IR zones. For the study, the authors applied variable return to scale and constant return to scale data-envelopment methods. The study finds eight railway zones to be efficient in the CRS model and thirteen railway zones to be efficient in the VRS model. The study further asserts that there is the deployment of surplus staff in some zones which needs to be shunted to other departments of IR. In addition to that, the staffs need to be made multi-skilled, and zonal railways restructured. The authors also suggest IR to formulate strategies to rationalise resources.

3   Objectives and methodology

This section contains the following two subsections namely research objectives and research methodology.

3.1   Research objectives

A thorough and exhaustive literature review of the research done during the last two decades could not bring to the fore any literature complete in itself talking about the latent reasons behind the fragile conditions of IR. Even the mentions of weak performance of IR are outdated and may not be relevant today. This gap created the scope for the present paper to study the subject in detail. However, the literature available did help us with framing the objectives of the study, designing the research process, and picking the tools for our study. Hence, the researchers have framed the following objectives in the context of IR:

- To examine the financial performance of IR.

- To identify the causes of lacklustre functioning of IR.

- To assess the logistical and safety issues in IR.

The idea behind these objectives is to draw the attention of the readers especially the policymakers towards the basic and inherent problems plaguing the IR and provide them with insights into them.

Figure 1   Schematic diagram of research methodology
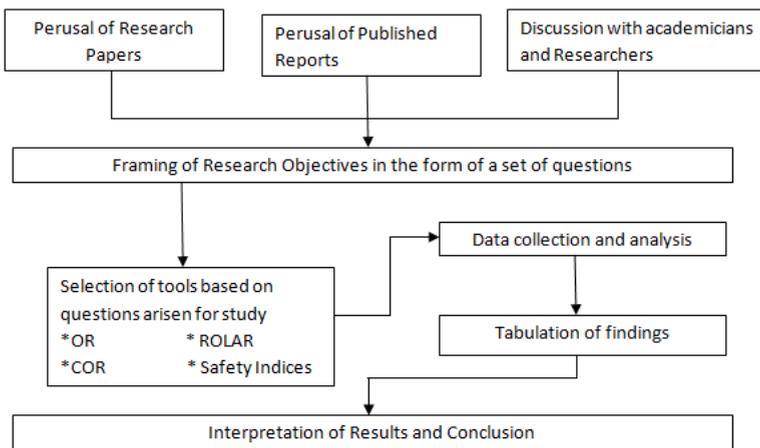
3.2   Methodology

The worrisome performance of IR has been analysed from two dimensions. The two dimensions encompass productivity and safety measures. The measures have employed efficiency metrics such as OR, COR, LOLAR, and safety indices, etc. to know the health of IR from different angles and to help pinpoint the basic and inherent causes of lackadaisical performance. For the purpose of analysis, data has been derived from

reports of the rail-budget, reports of the Comptroller and Auditor General of India and other reliable sources such as the Ministry of Railways. The schematic diagram of the research is below.

4 Analysis, results, and discussion

A large chunk of literature, including many reports of the Indian government and scholarly papers, buttress the 'all is not well' phrase, heralding an ominous signal to the health of the IR. Gupta and Sathye (2008) state that lack of accountability is the major reason behind the bad health of IR, which is further deteriorated by rising employee costs and worse productivity. Singhania and Sharma (2012) find that the unfavourable business environment for IR, such as intense competition from road transport and airlines, are the factors bringing about the poor performance of IR. But literature seems to be evading the chief indicators which bring to the fore the true face of the performance of IR from different angles. The indices used in this will unravel the real reasons behind fragile IR health.

4.1 Operating ratio

OR expressed in mathematical terms below, shows the cause and effect relationship. It is an index that shows the efficiency of an organisation (Trussel and Parsons, 2007), and the same is used to assess the performance of IR as well (George and Rangaraj, 2008). The higher the OR, the lesser the financial resources available for growth and expansion (Kapoor, 2020). To find out OR for any year, first operating expenses for that year are calculated, followed by operating income. Finally, operating expenses multiplied by 100 are divided by operating income. *OE* is calculated as follows:

$$OE = NOWE + APF + ADRF + ME \tag{1}$$

where

OE　operating expense

NOWE　net ordinary working expense

ADRF　appropriation to depreciation reserve fund

ME　miscellaneous expense.

OI is calculated as follows

$$OI = PFI + GFI + SI + S \& OI + MI \tag{2}$$

where

OI　operating income

PFI　passenger fare income

GI　goods freight income

SI　suspense income

S & OI   sundry and other income

MI   miscellaneous income.

Finally, to calculate or for any particular year, operating expenses are multiplied by 100 and the resultant is divided by the operating income of that particular year. Thus, it is the percentage of all the expenses incurred by the IR to the earnings from all the sources accrued to the IR. It is assumed that the lower the ratio, the higher the profit.

$$OR = \frac{OE}{OI} * 100 \qquad (3)$$

where

OR   operating ratio

OE   operating expenses

OI   operating income.

It is quite vivid from the ORs (see Figure 2) of IR that the logistical performance of IR has gone from bad to worse since 2007–2008, though with little hiccups. During 2017–2018, the OR of IR was the worst during the last decade, as OR stood at an abysmal 98.44 (CAG of India, 2019). Such an OR has not left sufficient funds with IR for growth and expansion. In fact, OR of IR would have ended at 102.66% had it not received an advance from NTPC and IRCON (ET Bureau, 2019). IR had received an advance of 47,619 million rupees from NTPC and 2381 million rupees from IRCON during 2017–018 (Dutta, 2019). Even mean OR (90.88) during the period 2001–2018 is not commendable and the lifeline of Indian transportation, as per Trivedi (2017), seems to be on the verge of financial collapse. The continuous paralysation of IR is on account of incessant increment in logistical expenses (Saluja, 2019), thereby trimming logistical profit (Sen, 2019). The mean OR of IR was found to be 93.57. The mean OR has been computed by summing ORs for ten years and dividing the result by the number of years. The OR has been checked for ten years, starting from 2009. The mean OR was calculated as:

$$mOR_{IR} = \frac{OR_{IR(09)} + OR_{IR(10)} + OR_{IR(11)} + OR_{IR(12)}, ..., OR_{IR(18)}}{10} \qquad (4)$$

As far as the performance of IR zone wise is concerned, East Coast Railway has been the most profitable zone which has maintained robust ORs of around 50%. The other profitable zones are South East Central Railway, North Central Railway, West Central Railway, and South Eastern Railway. The zone which is suffering the maximum loss is the North Eastern Railway, whose OR has been more than 200% during 2017–2018 and 2018–2019. Such zones, which are not only disturbing the profitability of IR but a burden on the IR, need urgent attention from policymakers. As a major chunk of expenditure goes towards salaries of staff, including pensions for retired employees (PRS Legislative Research, 2018); the revision of salaries by the Pay Commission makes the hope of improvement in OR bleak in no time (Ramakrishnan, 2019). The consistent financial pressure on IR (Mishra, 2016), growing consumer demand for better and user-friendly transport services, and the entry of rivals into transport services (Naidu and Shyam, 2018) are likely to push IR towards a debt trap. It is quite palpable that logistical services

provided by IR, especially to the passenger segment, have become costlier year by year, and IR is still unable to keep its expenses under check (Kapoor and Verma, 2019), which, in turn, handicaps it from going for coveted growth and expansion. There is improvement in the OR of Central Railway, Eastern Railway, East Central Railway, East Coast Railway, North Central Railway, Northeast Frontier Railway, Southern Railway, South Central Railway, South East Central Railway, and South West Central Railway, whereas the situation has deteriorated for the rest of the zones during 2018–2019.

Figure 2   ORs of IR (see online version for colours)

The ORs of Eastern Railway, Northern Railway, North Eastern Railway, Northeast Frontier Railway, Southern Railway, and South Western Railway have always been more than 100% during the period 2012–2019, implying that their logistical income is less than their logistical expenses. Whereas the ORs of East Coast Railway, North Central Railway, South Central Railway, South Eastern Railway, South East Central Railway, and West Central Railway have always been less than 100% during the last seven years, implying that these zones are profitable. OR of East Central Railway has also been less than 100%, barring the year of 2016–2017. The condition of North Western Railway started turning bad from 2017–2018 and the same is true with Western Railway, whose OR crossed 100% in the year 2016–2017 and has never improved since then.

Though the overall logistics profit of IR has increased from 16.66 billion INR to 60.14 billion INR, thereby registering a growth rate of more than 261% during 2018–2019, three zones of IR, namely Central Railway, Southern Railway, and Northeast Frontier Railway, has suffered losses during the same period. The change in profit percentage in the year 2018–2019 as compared to the previous year has been positive for the other thirteen zones. The change in profit percent was maximum for the East Central Railway, whose logistics profit increased from 3.54 billion INR in 2017–2018 to 11.22 billion INR in 2018–2019. The logistics profit of East Coast Railway in absolute terms was maximum (89.99 billion INR) in 2018–2019, followed by South East Central Railway. It is worth mentioning here that the profit earned by South East Central Railway in 2018–2019 was more than the overall profit of IR. It is because of the fact that the profit earned by INR was depleted in compensating for the losses incurred by other zones. It is well acknowledged that efficient rail transportation is very critical for the economic development of a country like India (ET, 2016). An efficient logistical system creates a scope for infrastructure development to meet the modern needs of different

stakeholders (Szmelter-Jarosz and Rzesny-Cieplinska, 2020). The inefficiency of IR in the provision of logistical services makes it prone to competition from other modes of transport, such as roadways (Vidyapeetham, 2018). Most zones have been found to be running at a loss as their OR is more than 100%. According to Dash and Panda (2018), it is time for IR to wake up to bring IR back on track or it will continue to lose its market share.

Table 1   ORs of zones of IR

Year	Zones of Indian Railways							
	CR	*ER*	*ECR*	*ECOR*	*NR*	*NCR*	*NER*	*NEFR*
2012–2013	97.82	178.86	92.19	44.50	113.15	59.68	200.01	178.39
2013–2014	100.23	176.76	99.58	48.34	110.12	64.04	207.49	193.08
2014–2015	101.85	177.27	95.24	51.25	117.65	64.13	193.47	187.08
2015–2016	98.13	180.56	90.28	50.56	114.97	61.98	196.52	185.71
2016–2017	105.00	165.27	101.83	53.78	118.85	70.50	197.01	130.45
2017–2018	111.10	181.30	97.50	52.00	116.90	66.90	201.80	169.20
2018–2019	107.00	179.30	92.30	51.10	117.40	66.00	208.50	155.80

Year	Zones of Indian Railways							
	NWR	*SR*	*SCR*	*SER*	*SECR*	*SWR*	*WR*	*WCR*
2012–2013	88.97	130.59	79.63	70.50	49.14	104.85	89.84	68.18
2013–2014	98.58	132.18	84.13	72.54	52.53	115.41	91.74	71.06
2014–2015	90.18	128.98	76.03	73.62	50.83	98.72	86.51	63.56
2015–2016	91.15	134.89	78.71	71.15	50.52	102.60	88.72	64.38
2016–2017	95.17	147.83	86.24	73.46	56.24	119.56	103.00	73.90
2017–2018	107.90	161.20	83.00	75.90	55.80	129.50	107.90	74.90
2018–2019	108.90	152.30	78.10	76.80	55.30	128.50	109.00	71.80

Notes: CR: Central Railway
ER: Eastern Railway
ECR: East Central Railway
ECOR: East Coast Railway
NR: Northern Railway
NCR: North Central Railway
NER: North Eastern Railway
NEFR: Northeast Frontier Railway
NWR: North Western Railway
SR: Southern Railway
SCR: South Central Railway
SER: South Eastern Railway
SECR: South East Central Railway
SWR: South Western Railway
WR: Western Railway
WCR: West Central Railway.

The emergence of IR financially is more significant keeping in view the simmering mandatory demands of the market, such as up-gradation of existing lines, introduction of new high-speed lines, conversion of the remaining coal-based into electric-based systems, high-speed networks connecting metropolitan cities, bullet trains, and special corridors to

bring down cargo costs. All of them will entail a large chunk of money, which is obviously possible only when IR has a healthy OR.

Table 2   Mean ORs of IR zones and their rankings

Zones	SECR	NR	WCR	NEFR	SER	ECOR	SCR	ECR
			Mean performance better than that of overall IR					
Rank	1	2	3	4	5	6	7	8
			Zones in profit					
Mean OR	52.91	52.91	69.68	69.68	73.42	73.42	80.83	80.83
			$\bar{x}\ OR_{ZONES\ (2012–2018)} < \bar{X}OR_{IR\ (2012–2018)}$					
			Mean performance worse than that of overall IR					
Zones	WR	NER	NWR	CR	SWR	NCR	SR	ER
Rank	9	10	11	12	13	14	15	16
			Zones in loss					
Mean OR	96.67	96.67	97.26	97.26	114.16	114.16	141.14	141.14
			$\bar{x}\ OR_{ZONES\ (2012–2018)} > \bar{X}OR_{IR\ (2012–2018)}$					

Source: Calculation

4.2   Capital output ratio

Another productivity measure of significance that checks logistical and financial efficiency is capital output ratio (COR). It indicates the quantum of capital needed to produce one unit of output. It is calculated as

$$COR = Capital / Traffic\ in\ NTKM$$

Table 3   Capital output ratio of IR

Year	Capital in billion INR	Total Traffic	COR
2012–2013	1,834.88	727.61	2.52
2013–2014	2,088.44	746.78	2.80
2015–2016	2,421.17	763.15	3.17
2016–2017	2,751.35	736.05	3.74
2018–2018	3,126.35	701.81	4.45
2018–2019	3,247.26	776.55	4.18

Note: Figures of capital and traffic are in billion.

Source: Computation based on data from Facts and Figures (2016–2017) of
Indian Railways, CAG Reports, and IR Budgets

The result of *COR i*s also very lamentable as the physical performance of IR has been deteriorating over the years since 2012–2013. The COR has increased from 2.52 paise (2012–2013) to 4.18 paise (2018–2019) against the capital employed. The logistical performance of IR in both the segments (passenger and freight) has become costlier during the last five years. However, COR in the year 2018–2019 has improved a little. The government needs to strengthen the internal revenues of IR by diversifying its freight

basket to help COR improve further. However, it is quite a herculean task for the enfeebled IR at a time when the Indian economy is passing through a recessionary trend due to the execrable crona pandemic-19 and IR is suffering a huge irreparable loss on account of passenger and goods transportation at their lowest points. With the subsidence of the disastrous crona pandemic-19, it is incumbent on IR to focus on growing passenger and freight revenues. The opening of dedicated corridors and starting of new passenger trains will indubitably enhance revenue generation.

4.3   *Return on logistics asset ratio*

The productivity of IR has been checked by employing return on logistics asset ratio (ROLAR). ROLAR checks as to how much profit is the asset employed in a system generating in percentage term. ROLAR has been calculated as

$$ROLAR = \frac{P_{IR(Yn)}}{LAV_{IR(Yn)}} * 100$$

where

$P_{IR(Yn)}$ logistical profit of IR any year

$LAV_{IR(Yn)}$ logistical asset value of IR in that year.

The share of profit in logistical assets employed in IR is quite thin. A large part of the profit (more than 90%) earned from freight service gets depleted by various expenses. The services provided by IR to passengers are running at an acute loss on account of privileges and relief provided by IR to customers, such as senior citizen concessions. ROLAR, which was at its peak during 2015–2016, again deteriorated in the coming years. The year 2017–2018 was the worst one as profits slumped drastically from 49,130 million INR to 16,656.10 million INR, registering a negative growth rate of more than 66%. The same thing happened with the profit of IR in the year 2015–2016 when LP slipped and missed the increasing trend and fell by around 53%, thereby, bringing down ROLAR from 2.15% to 0.91%.

Table 4   Return on logistics assets ratio of IR (1990–2019)

Year	LAV	LP	P*100/LAV
1990–1991	273,800.00	1,756.70	0.64
2000–2001	778,350.00	7,635.90	0.98
2010–2011	2,664,340.00	14,408.90	0.54
2015–2016	4,876,660.00	105,059.70	2.15
2016–2017	5,376,700.00	49,130.00	0.91
2017–2018	5,889,230.00	16,656.10	0.28
2018–2019	6,425,520.00	37,738.60	0.59

Notes: LAV = Logistical asset value; LP = Logistics profit.
     Figures are in million INR.
     Source: Calculation based on data compiled from Indian Railways Year
         Books

ROLAR would have increased from 2.015 and 0.91 to 9.5 and 7.4 in percentage terms during 2015–2016 and 2016–2017 had the different passenger services of IR not suffered losses in those years. All the segments of passenger services, namely AC-Ist class, Ist class, AC 2 Tier, sleeper class, second class, ordinary (all class), and EMU suburban services, excluding AC 3 tier and AC chair car, suffered losses which came up to 359,358.8 and 400,613.8 million rupees during 2015–2016 and 2016–2017 respectively. The maximum loss is incurred by the ordinary class, followed by the second class and the sleeper class. It is quite glaring that none of the segments of passenger services barring AC 3 tier and AC chair car have registered a profit during the last five years. As per the Report of the Comptroller and Auditor General of India (2019), only these two segments could recover operational costs and make a perceptible profit during 2012–2017. The contributory factors behind non-recovery of full cost by these segments are subsidies, free passes, and concessional tickets given by IR to passengers.

Table 5   Types of train accidents during last six years

Year	Collisions	Derailment	Level crossing accidents	Fire in trains	Misc.	Total	Train accidents per million train kms
2012–2013	6	49	58	8	-	121	0.11
2013–2014	4	53	59	7	3	126	0.11
2014–2015	5	63	56	6	5	135	0.12
2015–2016	3	65	35	0	4	107	0.09
2016–2017	5	78	20	1	0	104	0.09
2017–2018	3	54	3	13	0	73	0.06

Source: Compiled from several Annual Statistical Statements of Indian Railways

Table 6   Casualties: the number of passengers killed and injured in train accident during last six years

Year	Number of passengers killed	Number of passengers injured	Total casualty	Casualties per million passengers carried
2012–2013	60	270	330	0.039
2013–2014	42	94	136	0.02
2014–2015	118	340	458	0.05
2015–2016	40	126	166	0.02
2016–2017	195	346	541	0.07
2017–2018	28	184	212	*

Source: Compiled from Several Annual Statistical Statements of Indian Railways

4.4   Safety measures of IR

The safety index of IR, it seems, has been slightly improving since 2014–2015. The number of accidents has gone down from 135 during 2014–2015 to 73 during 2017–2018, registering a decline of 46%. It is quite surprising that during the period commencing April 1, 2019, till February 24th, 2020, IR did not register any fatalities and earned the best safety record (Business Today, 2020). Such a great performance of IR in terms of safety transpired for the first time since the introduction of IR in India. However, a conclusion can not be drawn based on a small period of time and it would be unwarranted to brand IR as improving in matters of safety. During 2012–2018, the derailment of trains has been a thorn in the flesh for IR. Derailment alone has been the biggest type of rail accident in India, with a share of more than 55% of overall accidents during the last six years. The IR had been, by and large, unsuccessful in controlling the number of accidents due to derailment during the period 2012–2018. Accidents occurring due to level crossings have remarkably gone down, thereby pushing down train accidents per million train KMs. There are broadly two causes of rail accidents, vis. man-related and machine-related. Most accidents occur for man-related reasons. Of man-related reasons, the top two are errors by railway staff followed by sabotage by miscreants. There have been 1,843 casualties during the past six years, out of which 483 passengers (26%) were found to be dead and the remaining 1,360 passengers (74%) suffered injuries. Casualties per million passengers carried have shown a fluctuating trend during the period mentioned above. The year 2016–2017 was the worst one when the casualty rate was as high as 0.07.

5   Conclusions and implications of the research

IR is beset with a chiefly chronic financial affliction which is, in turn, begetting other related problems. The OR has, over the years, deteriorated, resulting in the incapacity of IR to go for coveted growth, expansion, and modernisation. Service delivery, as indicated by the capital output ratio, has also become costlier, weighing IR further down. Burgeoning consumerism and the incessant provision of user-friendly services by other modes of transport are enfeebling the IR too. The revision in salaries and pensions on account of the seventh pay commission has made the hope of a turnaround bleak in no time and the ROLAR is also not promising. IR, at this juncture, ought to wash its hand off social obligation and put an end to subvention in the form of subsidy to different stakeholders in order to seek, better late than never, revival. It is, therefore, recommended that the hefty operating subsidies due to inadequate subsidy policies be withdrawn. Along with that, archaic pricing should be done away with and IR needs to adopt a demand-based pricing strategy lest IR should collapse in toto. Nevertheless, IR has improved a little on the safety front, but it still needs infrastructure development to restrain accidents and fatalities. This study complements the findings of other researchers such as Anand and Gupta (2018), Bhanot and Singh (2014), Bhatia and Sharma (2021), and Vaidiya (2018).

One of the chief contributions of this paper encompasses the in-depth analysis of the performance of IR from two main dimensions: financial and logistical. The requisite indicators were employed to analyse the problems which could not be found in other research related to this study. However, due care has been taken in developing the

theoretical framework and mathematical model building so that they serve the intended purpose. As far as the policy implications are concerned, this study will assist the policy makers and transport planners under IR in understanding the inherent causes of fragility in IR and help them take suitable course of action. By and large, it will help the ministry take appropriate steps, such as regulation of fares and pension systems. It will also help future researchers pursue research on IR with a core focus on a specific zone. By and large, this research is expected to give insights to the readers into the causes of the lacklustre performances of IR and the required solutions to them.

6   Limitations of the study and directions for future research

The major limitation of this research includes the collection of data from secondary sources, such as several reports of the IR and journal articles. Though data from official sources is reliable, the inclusion of primary data might have added to the quality of the paper. In addition, data from sources which have not undergone peer-review has also been attempted to be kept to a minimum. Future research may address this limitation by incorporating inputs through interviews and discussions with the concerned people from IR. Future research might also be conducted on the performance of IR with special reference to a particular zone.

Funding

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