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The opinions expressed in the articles printed in this Journal do not necessarily represent the views of the Institute. They are offered as representative examples of opinions and analysis to the readers of the Journal.

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From The Editor's Desk

"You cannot improve one thing by 1000%, but you can improve 1000 little things by 1%."

- Jan Carlzon

This quote captures a truth especially relevant to the world of transport and logistics. While grand projects and landmark reforms often make headlines, it is the steady accumulation of small, thoughtful improvements that truly transforms a sector over time.

As I step into the role of Editorial Adviser of the Journal of the Institute of Rail Transport (IRT), I see this publication as one such quiet but persistent force for progress. By offering a platform for diverse voices-from seasoned professionals to young researchers-it helps surface the ideas, innovations, and critical reflections that shape our shared future.

This issue also marks the resumption of the Journal's publication after a one-year hiatus. The past year saw a period of internal re-organisation within the Institute and a temporary slowdown in article submissions. While this pause was unintended, it offered us a moment to reflect and regroup. We return with renewed energy and a clear editorial vision to take the Journal forward in a more consistent and impactful direction.

This issue reflects that mission. Bhaskar Roy's "Nostalgia of the Indian Railways" evokes the enduring emotional connect many of us feel with our rail heritage. Madhukar Reddy's "Vande Bharat

Train Services – Some Critical Concerns" provides a grounded assessment of a modern initiative. We also explore emerging technologies through S.S. Mathur's article on Cyber-Physical Systems in Indian Railways, and Shri Abhishek Prabudha's piece on AI and EVs in Logistics

Notably, we conclude Sanjeev Hariharan's well-received five-part series on the Modernisation of Railway Stations. In addition, Dr. Veni Mathur examines the scope for Public-Private Partnership in India's port sector, while Prof. (Dr.) Sudhir Das takes us beneath the surface-literally-with his piece on micro tunneling under Kolkata's East–West Metro, titled "The Hidden Lifelines."

Each of these contributions adds a small but meaningful piece to the larger puzzle of how we move people and goods better, faster, and more sustainably.

I invite young professionals, students, and practitioners to contribute. No experience is too modest, no observation too minor. Your voice matters-and it may just provide the next 1% improvement we need.

Let this journal be your voice.
Happy reading!

Purushottam Guha
Editorial Adviser

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NEWS

Institute of Rail Transport after a long wait of 15 years have now decided to open its enrolment for Life Membership. The society will give membership to about 250 eligible applicants.

All officers of Indian Railways, Public Sector Undertakings and Central Government can now apply for membership. Applicants associated with transport and logistics sector will find great professional value in the membership.

All applications received shall be examined by a nominated committee and those recommended shall be put up for the final approval of the Governing Council

The selected candidates will be informed and requested to deposit the necessary one time membership fee of Rs.10,000/- (Non Refundable). The Railway officers on becoming members shall be eligible for partial refund of fees from their office in terms of Railway Board letter No.E(G)2004 FE1-5 dated 16.09.2004

Applicant can send the application in the prescribed format to the Institute's Address as given below.

Membership Application form and Railway Board's circular are available in the IRT Website www.irt.indianrailways.gov.in

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Abhishek Prabudha
Co-Head, Client Explore, DELHIVERY

"The best way to predict the future is to invent it"

- *Alan kay*

Logistics Reimagined: How AI and EVs are Transforming the Future of Transport

Introduction: A Decade of Shift and Signals

In the last decade, I've witnessed something remarkable-logistics transforming from a back-end support function into a strategic growth lever. The reasons are clear. Online shopping exploded. Cities grew denser and more complex. Customers began expecting not just fast delivery, but perfect delivery. And climate change forced us all to rethink the way we move goods.

In the middle of this evolution, Artificial Intelligence quietly made its entrance-not with the fanfare of science fiction, but with the steady, reliable cadence of a tool that works. What surprised me was how seamlessly it integrated into our day-to-day operations. At its best, AI didn't replace us-it sharpened our judgment. It helped us see patterns we missed, spot issues before they erupted, and make smarter decisions faster.

From my time at Flipkart and Delhivery, to more recent experiences with EV-based logistics, I've come to believe that AI is not just transforming logistics-it's rebuilding it from the ground up. What

follows is a look at how that transformation has played out in practice, the lessons we've learned, and what comes next in this unfolding story.

Challenges and Solutions: AI in Action Across Indian E-Commerce Logistics

Every company that scales up in Indian logistics hits a wall-usually faster than expected. The wall looks different depending on where you are. At Flipkart, it was predicting what would sell and where. At Delhivery, it was making a sprawling network operate like a single organism. And with EV logistics, it was about solving for range, uptime, and sustainability-all at once.

Flipkart: Forecasting the Unpredictable

Sale days at Flipkart were adrenaline-filled events. Teams worked late nights. Dashboards blinked with red zones. One miscalculation in demand forecast, and you'd have stockouts in Patna while warehouses in Bengaluru overflowed with unsold items.

To solve this, we turned to a machine learning model that could learn from past sales, upcoming marketing pushes, even weather trends. But the real magic was in how we layered data-combining behavioral patterns, search queries, and local events into one coherent forecast.

What Changed:

- We saw a 20% boost in stock availability where it mattered most.
- Our delivery success on the first attempt improved noticeably.
- And planning time dropped dramatically, freeing up our teams for more strategic work.

It wasn't just data science-it was operational clarity at scale.

Delhivery: Teaching the Network to Think

When I joined Delhivery, the biggest challenge wasn't scale-it was agility. With over 18,000 pin codes, the network was massive. But traffic, driver shifts, and even local holidays could throw plans off balance in minutes.

We started using reinforcement learning-basically letting the system learn by trial and error which delivery paths worked best. We also built heat maps of underperforming zones and redesigned service areas accordingly.

The Results:

- 15% gain in route efficiency, and not just in metros-tier-2 regions benefited even more.
- Better ETAs led to a drop in customer complaints.

- Drivers felt the difference too-less backtracking, more consistent shift outcomes.

It was like giving the network a sixth sense.

EV Fleet Operator: AI Meets Energy Logic

Now, EV logistics was a completely different game. Suddenly, we had to factor in battery health, charging station availability, and energy usage patterns-not just delivery time.

We built a smart layer of AI to guide our dispatch: Which vehicle should go where? When should it charge? How much charge was too much?

We even fed in solar generation data to time our charging to greener hours, reducing the carbon footprint even further.

What We Gained:

- Idle time dropped by nearly a third.
- Battery life improved by 18%, extending asset use.
- And our overall emissions profile improved drastically-a key win for sustainability.

In each case, AI didn't solve the problem on its own. But it gave us new tools, sharper insight, and the ability to act with confidence in situations where instinct alone wasn't enough.

Future Outlook: The Generative Frontier and AI-EV Convergence

If the last few years were about solving problems, the next few are about reimagining possibilities. AI has matured past the basics-routing, forecasting, exception management. What's coming next is more creative, more intuitive, and more interconnected. I've started seeing glimpses of it in the field, and it's nothing short of game-changing.

Generative AI: From Problem Solver to Thought Partner

We're entering a phase where AI doesn't just analyze-it co-creates. Generative AI models can now simulate entire logistics plans, generate content, and interact conversationally in ways that feel surprisingly human.

I've experimented with GenAI tools that allow supply chain planners to run "what-if" scenarios with a single sentence: "What if we shift 40% of Delhi's deliveries to electric during monsoon season?" In seconds, it generates a plan-with constraints, costs, and workarounds. That kind of power used to take a week of Excel sheets.

Even customer experience is getting an upgrade. Support bots are evolving from rigid scripts to responsive agents that understand

nuance, intent, and empathy. It's not just efficient-it's human-friendly.

Digital Twins: A New Layer of Operational Foresight

Another game-changer is digital twins-virtual replicas of supply chains. Picture this: your entire fleet, your hubs, your inventory-all mirrored digitally in real time. You can simulate delays, reroute traffic, test warehouse layouts, and even optimize energy usage, all without touching a single truck.

It's like having a practice ground for reality. You can fail safely, learn instantly, and adapt continuously.

EV Meets AI: Where Energy and Intelligence Intersect

Electric logistics is scaling fast-but it's AI that's making it operationally viable. Without intelligent charging, range-aware dispatching, and predictive battery management, EV fleets would struggle to match the reliability of ICE vehicles.

In one pilot, we used AI to forecast energy demand and auto-schedule charging based on solar availability and grid prices. Another model helped us calculate the true carbon cost per delivery route-so we weren't just fast, we were clean.

This convergence-AI plus EV plus sustainability-isn't just a trend. It's the blueprint for the next decade of logistics.

Conclusion: Rethinking the Fundamentals of Logistics

When I look back at the last few years, one thing stands out: AI didn't just improve how we worked-it changed how we thought.

At Flipkart, we learned that forecasting wasn't about numbers alone-it was about trust. At Delhivery, we discovered that a network could actually think for itself, if we gave it the right feedback. And in EV logistics, we proved that speed and sustainability don't have to be trade-offs.

These lessons weren't theoretical. They were learned through real chaos, real deadlines, and real impact on people's lives-especially the ones doing the hard work on the ground.

Looking ahead, the logistics leaders of tomorrow won't just need to understand supply chains. They'll need to think like system designers, data storytellers, and environmental stewards. The lines are blurring between technology and operations, between efficiency and empathy.

AI won't solve everything-but it gives us a better lens. One that sees ahead, learns constantly, and adapts in real time. And as we enter

this new phase, the real opportunity isn't just in what we can automate-it's in what we can imagine.

This isn't about the future of logistics. It's about the future of how we move, connect, and care for the world around us.

Bhaskar Roy
Former Project Director, TATA Project Ltd. & VP Ramakrishna Mission, New Delhi

"The Railways are not just steel and steam -
they are memory, motion and magic"

- *Anonymous*

Nostalgia of the Indian Railways - through the Eyes of a Rail Fan

The fascinating story of the railways in India which brought a country together, changing lives, forging destinies, and building an enduring legacy which lives on for over one hundred and seventy years, is also a journey of romanticism and nostalgia. Once derided as a relic of our colonial past, born primarily with the intent of serving strategic and commercial interests of our imperial masters, it has now rightfully emerged as the lifeline of our nation.

The 'Vestibule' Express

I was lucky to have been born in a year which, to my mind, heralded a paradigm shift in the history of the Indian Railways. With the introduction of the biweekly 81 up/82 down Air conditioned Express between Howrah and New Delhi (via Grand Chord) on October 1, 1956, it was for the first time that the middle class could afford to travel in air-conditioned comfort at reasonable cost.

Its AC Chair Car became an instant hit and its red and orange coaches were interconnected with each other through what was

called in those days as a 'vestibule'. This enabled the Chair Car passengers to visit the Dining Car for their meals at appointed times, as per staggered time slips handed over to the passengers by the Catering Manager so as to avoid over-crowding of the Restaurant at any point of time. The Dining Car was nothing less than a 5-star Restaurant with a menu consisting of Continental as well as Indian cuisines with the waiters sporting smartly starched full white colonial uniform along with the trademark feather look turbans. The train also had a corridor type 'Airconditioned' class coach for the elite which corresponds to the 'First AC' of today. A non-AC First Class coach (corridor type) was later added as also a couple of non-AC sleeper coaches called '3 Tier Sleepers' in those days. The bare wooden berths in these second class sleeper coaches were patently uncomfortable till Madhu Dandavate, undoubtedly one of the most effective Railway Ministers ever, elevated this section of passenger trains by introducing in the year 1977 a soft foam topping placed on the hard wooden slats. This novel innovation has by now made billions of train journeys far more comfortable than they would otherwise have been.

Curiously, people called this train by various names; most of them called it the 'Vestibule' while others referred to it as the Deluxe or AC Express. A railwayman, one of the Yard Masters of DHN no less, told me they called it the 'Crack'. Whatever name one called it by, the fact was that it became very popular as a comfortable train

which took just about 24 hours to reach New Delhi from Howrah with very few halts on the way (ALJN, ETW, CNB, FTP, ALD, MGS, GYA, DHN, ASN) with its punctuality seldom disturbed.

Summer and winter holidays meant that we made a beeline for Calcutta, my maternal grandfather's place, hence I have lost count of the number of times I've travelled by the 'Vestibule' from my earliest childhood till around my teens when the Rajdhani Express was introduced. My father being an ardent 'railfan' - a term coined for people who loved and enjoyed the railways in its various aspects - it was no surprise that I would also become one before long. Checking on the loco link before, during or after a journey and noting its road-number and the shed it was homed in became a mandatory ritual which I enjoy doing even today in my sixty eighth year. A word or two with the loco pilot was and still is an added bonus. My father also taught me the pleasure of spending hours with a railway time-table, whether the Zonal or All India, or the privately published 'Bradshaw' as it was often called in those days, which took us places without spending a single paise !! Bradshaw, I later learnt, was an English cartographer, printer and publisher who was the first to publish combined railway guides and time tables. The book stores at most stations were those of A. H. Wheeler & Sons of Allahabad and Higginbothams of Chennai (then Madras) in the South.

I still remember the majestic and mighty steam WP's (Canadian engines as they were initially called but later manufactured at

Chittaranjan) that hauled this train till at least the early 1970's when its steam traction was taken over progressively by diesel (WDM 2) and electric locomotives (imported WAM 2 & 3 of ASN). How can I forget the 'triple tunnels' between Gurpa and Gujhandi in the morning as the Grand Chord route cut through the Ghat section along the Chota Nagpur hills. This 22 KM stretch on the Gaya-Koderma section was undoubtedly the best part in the entire journey, providing as it did awesome and exotic scenery consisting of magnificent curves, gradients, viaducts and overall lush greenery all around. As a young railfan I would eagerly wait for the Vestibule to stop at Gurpa for a few minutes while a steam WG got attached to its rear to help pushing it up the sharp gradient till Gujhandi. (I later learnt that the WG here acted as the 'banker' to the train in operational parlance). It was beyond my wildest dreams that this treacherous section, often inhabited by wild animals, would one day be electrified by a multinational company which I was destined to serve after a couple of decades!

The AC Express was such a fascination in those days that the renowned film-maker Satyajit Ray, a rail-buff himself, based one of his movies 'Nayak' on the moving AC Express in the year 1966. Much of the interaction of the film-hero Uttam Kumar with the journalist Sharmila Tagore was shot in the Dining Car while the rest was shown on the AC Chair Car and the First-Class Air-Conditioned coach.

The introduction of the Rajdhani Express spelt bad days for the 'Vestibule' by the early 1970's when more stoppages were added, the no. of AC Chair cars drastically replaced with non-AC Sleeper coaches and the lovely Dining Car brutally replaced by the ubiquitous 'Pantry Car'. By that time my childhood dream of the Vestibule lay in tatters as my father switched his loyalty to the Rajdhani thenceforth. And to top it all, the Vestibule or the Air-conditioned Express was re-christened as the Poorva Express. It now stops at 20 stations (via the Grand Chord) as against 9 in its previous 'avtar' and at 24 stations if it is the 'via Main Line' version which was introduced in 1969 as the 103/104 AC Express. It seldom maintains time, rake maintenance is just about average, as I heard, and the food served by the Pantry Car is better not eaten. Mercifully, with the phased introduction of high-speed electric traction, the Poorva takes the same amount of time to travel between Howrah and New Delhi in spite of the introduction of more than twice as many commercial stoppages on the way.

When we sometimes ponder why our trains lose so much of time, except of course the premier ones like the Rajdhanis and Shatabdis which get the highest priority, what emerges is the fact that the reason is mainly political. The introduction of 'new trains' by successive Railway Ministers almost every year, even in the already saturated 'trunk routes', with hardly any additional infrastructure, might have pleased his constituents but became a nightmare for the

Railways to administer. With reduced line capacity and the need to move freight trains alongside passenger services, the inevitable is bound to happen - delays and more delays. A case in point is the stretch between Naini Jn and Prayagraj (Allahabad). Even till recently, trains got abnormally delayed due to bunching of too many trains on this section. Luckily, we now have a Dedicated Freight Corridor, albeit for a limited stretch on the Delhi-Howrah trunk route, which has resulted in improved punctuality to a certain extent due to the minimal decongestion. Hence increasing line capacity is certainly called for.

The Rajdhani era

March 1, 1969 was a veritable turning point in the history of the Indian Railways when its first high speed, limited stoppage premium train, the Rajdhani Express (101 up & 102 Dn) chugged out of New Delhi for Howrah. Hauled by a WDM 4 Diesel EMD locomotive of MGS shed, imported from the General Motors, U. S. A, it took around 17 hours to reach Howrah (as against the 24 taken by the AC Express) with a maximum speed of 120 kmph. Manufactured indigenously at the Integral Coach Factory, Perambur, it had five AC Chair Car coaches, an Air conditioned Sleeper coach, a Pantry Car and two Luggage cum Guard vans. It ran twice a week both ways and had stoppages only at CNB, MGS and GMO (later shifted to DHN). Catering was included in the fare which was Rs. 90 for the Chair Car and Rs. 180 for the AC Sleeper. Traveling by the Rajdhani

became the latest status symbol of the quintessential Bengali in those days, awestruck by the luxury travel it provided, and the possibility of rubbing shoulders with the high and mighty.

I was lucky to have travelled by the Rajdhani to Howrah with my mother less than three months after its introduction and it was such a memorable experience. The coaches were still marked SR (from its birthplace at Perambur near Madras of those days) although its primary maintenance was carried out at LLH. As far as I can remember, we were hauled by WDM 4 18001 (from MGS) end to end. The food (from soup to desserts) served enroute was delicious and filling, a far cry from what is served today, and the Catering Inspector, one Mr. B. P. Chatterjee, introduced himself to each and every passenger and politely asked us whether the food was good and if we would like to have some more chicken ! The waiters sported smart liveries and went about their business in the most professional manner. Obviously the catering was managed departmentally by ER and there were no cause for complaints.

The HWH Rajdhani was hauled at least for a decade by the WDM 4 locomotives and after the electrification of the entire Delhi-Howrah route completed, it was progressively hauled by a WAM 4 (GZB), twin WDM 2 (of HWH DS), WAP 1, WAP 4, WAP 5 (all from GZB ELS) and finally WAP 7 (GZB & HWH). Its AC Chair Car coaches were also replaced by 3AC coaches for better passenger comfort.

With the introduction of the NDLS-HWH Rajdhani the clamour for more such premier trains naturally arose and the Bombay-New Delhi Rajdhani ran on the Western Railway tracks in 1972. Gradually, more state capitals like Chennai, Trivandrum, Patna, Bhubaneswar, Ahmedabad, Secunderabad, Bilaspur, Jammu, Guwahati, Agartala and Ranchi also got their share of respective Rajdhanis.

Curiously enough, the two Mumbai Rajdhanis and the Patna, Bhubaneswar and Agartala Rajdhanis have since received the more sophisticated 'Tejas' coaches but the oldest one in the pantheon, the Howrah Rajdhani is still waiting for its due. In fact, the SDAH-NDLS Rajdhani rakes do not even have a uniform colour combination of its livery; its a medley of the Humsafar, Duronto and standard red-grey LHB coaches. The reason behind this apparent neglect of the HWH & SDAH Rajdhanis is amply clear to the discerning reader of this article.

One is tempted to compare the services offered by the Rajdhani in its present LHB avtar with that provided 54 years back by the smart looking but exclusive red and cream ICF stock. Generally speaking, we expect things to improve over a period of time. Sadly, the reverse has now become the order of the day. Contracted out by the IRCTC to private entities, the overall quality and quantity of food has taken a severe beating with a few items like the soup and fish fry from the

dinner and the fruit and sandesh (sweet) from the breakfast menu having disappeared altogether. Endless complaints and suggestions for improvement have regretfully fallen on deaf ears. However, given the situation, its good that one can now exercise the 'no-food' option during the reservation itself.

Secondly, even with improved technology - lighter LHB coaches, 6125 horse powered WAP 7 locomotives, automatic signalling systems en route and MPS upto 130-140 kmph, the Rajdhani still takes 17 hours and15 minutes to cover the NDLS-HWH route which is the same time taken when it was first introduced 54 years ago. Even for other trains - premier, superfast and others - the sectional speeds have recently been upgraded from 110 to 130 kmph but this has not resulted in reduction of the total journey time which remains the same. This phenomenon is baffling and needs a review by those responsible for time table preparation.

The Shatabdi and Vande Bharat age

The Shatabdi Expresses were introduced in 1988 during the tenure of Railway Minister Shri Madhavrao Scindia to commemorate the Birth Centenary of Pt. Jawaharlal Nehru. These are high speed premier trains on shorter routes of up to 7 hour trips with AC Chair Car and AC Executive Class accommodation with food included.

The Vande Bharat Expresses introduced a few years back is yet another experiment in improving passenger services by providing faster services along with enhanced passenger comfort through an integrated train-set regime. I was once lucky enough to travel by the

Vande Bharat from ALD to BSB. Excellent decor, automatic doors, fastest pick-up.... the list goes on. But when I asked the on-board food vendor for a non-vegetarian lunch, he snapped at me as if it was nothing less than blasphemy to demand non-vegetarian food on a train going to the holy city of Benaras. I sensed that it would be prudent not to argue with this man and quietly settled for a plate of dal-chawal. I realised later that things had changed and my secular India was left far behind.

Now in my twilight years, as I look back as a rail fan, there are many issues which disturb me while some others cheer me up. While I wish to see my Indian Railways in the pink of health always, here are some of my concerns:

1. The problem of unauthorized passengers entering forcibly into the reserved coaches (non-AC Sleepers as well as 3AC) making the lives of passengers with bonafide reservation miserable is not being adequately addressed by the Railways. Even the GRP/RPF personnel have failed to clear the coaches of these unauthorized passengers as per the repeated complaints received from them on a daily basis. This is true generally of trains passing through Eastern U. P, Bihar and Jharkhand, especially during festive seasons.
2. There is much talk of 'negligence' and 'human error' in case of accidents which seem to be on the rise. This can happen due to various factors, including exhaustion due to shortage of

manpower and overworked train running staff. The cause of the negligence, therefore, needs to be found. There are reports that Indian Railways has over 3.12 lakh vacancies, a staggering number of these posts directly related to railway safety, maintenance, operations and signalling. Hence, these vacancies need to be filled up post haste.

3. The Balasore and other accidents last year is a warning sign for the railways. Recurring accidents point to systemic failures that need urgent attention at all levels.
4. Indian Railways runs some of the slowest trains in the world and yet its safety record has declined in recent years. Curiously, about a decade back, a Railway Minister was unceremoniously sacked by his own party supremo, days after he had presented a good Railway Budget which created a Safety Fund and also proposed a Member (Safety) at the Railway Board.
5. Due to the inevitable congestion of our trunk lines what we need is capacity expansion by laying new railway lines. Just as the government is laying expressways adjacent to existing highways, our railways require more tracks to deal with this kind of congestion.
6. The most obvious impact of congestion is on track maintenance. Ideally, tracks need to be shut down for 2–6 hours at a time for proper inspection and maintenance. But this level of congestion rarely allows such a luxury, and one can easily imagine the consequences of hurried inspections and postponed or rushed

maintenance-not just of tracks, but also for signals, the overhead electrical supply lines, etc.

7 Acute congestion also tends to slow down trains, resulting in delays, as was discussed earlier.

8. Globally, as the speed of trains has increased, safety has also improved along with punctuality, riding comfort and capacity. Today, high-speed railway lines in these countries offer far better safety, service, punctuality, and comfort than the slower lines they have superseded. We have to view this phenomenon from our experience.

9. There are thousands of complaints from passengers regarding overcharging by IRCTC contractors for the meals supplied from Pantry cars. Curiously, threat to report the matter to 'Rail Madad' leads to an immediate refund of the overcharged amount but other passengers who may not be aware of the actual rates may not be so lucky.

10. I have often wondered what exactly has been achieved by increasing the no. of Zonal Railways from the initial 9 zones to 17. Apart from the huge expenditure incurred in setting up new infrastructure for the newly created Zones, the bifurcation has meant that Operations have become more complex as the Zones try to optimise their performance leading to less seamlessness. These Zones now enjoy less autonomy as they have got aligned to the state capitals. The work of coordination by the Railway Board had also increased substantially. However, on the positive

side, inspection of stations and monitoring have improved as the jurisdiction is reduced and the possibility of intensive inspections is more.

11. We heard a lot of criticism when the stand alone Railway Budget was done away with. However, to be fair, budgetary support from the Finance Ministry has now increased after this abolition.
12. The ACD (Anti Collision Device) needs to be installed in all locomotives across the railways.
13. Over the past 20 years, rail transport has consistently lost market share in both freight and passenger traffic to evidently far more expensive air and road transportation. It requires far more investment to build highways and air networks. Not more than 2–4 per cent of the population, it is estimated, can afford private vehicles or air travel. And yet, this is the direction in which we see a shift.
14. Even as the railway budget has increased in recent years, resources are arguably being utilised not for improving competitiveness, safety or punctuality but on more cosmetic changes like 'world-class railway stations' and fancier inter-city trains like Vande Bharat or the bullet train between Ahmedabad and Mumbai. This has been confirmed by a recent report by the Comptroller and Auditor General of India. Spending on additional infrastructural requirements for capacity enhancement has been stressed instead.

15. A case of misplaced priority is the Bullet train between Ahmedabad and Mumbai was not really needed. The decision to run it on a standard gauge at an estimated cost of Rs 350 crore per kilometre was also a mistake. Since most Indian trains run on broad gauge, what it means is that only the bullet train will be able to run on this new track. It would have been cheaper to upgrade the existing tracks or lay a new broad gauge track at an estimated cost of Rs 50 crore per kilometre if the bullet train had followed the existing standard. To become viable, the bullet train will require 100,000 passengers to travel daily, at fares unaffordable to most citizens. It is, thus, a white elephant, because much of the cost was borne by Japan, a loan which has to be paid back eventually. Even the Japanese have estimated that only after 10 years will the train be used by 35,000 passengers a day. Eventually, the total cost of our lone bullet train could go up to Rs 7 lakh crore, factoring in the loan repayment. The amount would have been better spent on laying new broad gauge lines and upgrading existing lines to run trains at an average speed of 160–250 kmph versus this bullet train's expected 320 kmph.

16. Let me emphasize once again, even at the cost of repetition, that adding new trains without creating new capacity is eating into existing capacity and adding to the overall congestion.

17. Late arrival of trains, particularly long-distance and passenger trains results in poor sanitation levels in non-AC coaches, particularly in their toilets.

18. The below standard quality of food served on the Indian Railways, with a very few exceptions, has been deplored by the vast majority of passengers. However, no visible steps have been taken to improve the situation on the ground.

Let me end this journey of nostalgia and concerns with a poem we learnt in our 4th standard from our poetry book 'Silver Bells' :

From a Railway Carriage
by Robert Louis Stevenson

"Faster than fairies, faster than witches,
Bridges and houses, hedges and ditches;
And charging along like troops in a battle,
All through the meadows the horses and cattle:
All of the sights of the hill and the plain
Fly as thick as driving rain;
And ever again, in the wink of an eye,
Painted stations whistle by.

Here is a child who clambers and scrambles,

All by himself and gathering brambles;

Here is a tramp who stands and gazes;

And there is the green for stringing the daisies!

Here is a cart run away in the road

Lumping along with man and load;

And here is a mill and there is a river:

Each a glimpse and gone forever!"

A Madhukumar Reddy
Former Principal Executive Director, Railway Board

"Speed is irrelevant if you are going in the wrong direction"
- Mahatma Gandhi

Vande Bharat Train Services: Some Critical Concerns

The Vande Bharat Services introduced over the past six years mark a clear shift in the class of train services provided by Indian Railways (IR). Vande Bharat services, with their modern, aero-dynamic exterior have been branded as India's first indigenous 'semi high-speed trains.'[1] These services have generated widespread euphoria, owing to the fact that train-sets[2] for intercity travel have been introduced for the first time in India. Assuredly, the Vande Bharat trains are a distinct class of trains that justify the exultation they generate as they are capable of running at speeds up to 160 kmph with higher acceleration and internal amenities matching the best in class. Yet, is the Indian Railways going overboard with the deployment of its flagship innovation in a manner that is indifferent to its saturated network and its non-premium traveller? This article is an attempt to identify the core reasons why the Vande Bharat trains merit celebration, trace the method of induction of these

[1] Press Note, Press Information Bureau – 2 September 2024
[2] Train-sets are not hauled by locomotives but have a distributed power system similar to those trains operated on Suburban and Metro systems

services and discuss issues and challenges that are likely to arise due to a rapid surge of these services.

Genesis of Vande Bharat

The idea of Vande Bharat has seemingly captured the imagination of the Indian traveller. How did the idea of an intercity train-set capable of high speeds germinate? To be sure, intercity expresses with high speeds and semi high speeds, have been known to exist for over 90 years across advanced railway systems. The first intercity train-set was an aero-dynamic, diesel electric multiple unit (DEMU), with the speed of 160 KMPH, launched in 1933 by the German Deutsche Reich Bahn. This service which ran between Hamburg and Berlin was nicknamed the "Flying Hamburger" for its speed and design.[3] Some 30 years later, the Shinkansen, meaning the 'new trunk line' was operated between Tokyo and Shin-Osaka as the world's first high speed railway system with a maximum Commercial speed of 200 Kmph.[4] This train had a spitzer shaped nose-cone and was nicknamed the 'bullet train'. Then came the TGV (Train a' Grande Vitesse) which was launched by the state-owned SNCF in France, in the year 1981. This train which operated Commercial speed of 320 kmph had its inaugural run between Paris and Lyon.[5] Up next was the German ICE or Intercity Express which

[3] https://www.railwaywondersoftheworld.com/flying-hamburger.html
[4] https://www.asme.org/about-asme/engineering-history/landmarks/211-tokaido-shinkansen
[5] https://www.theguardian.com/world/from-the-archive-blog/2021/sep/15/france-high-speed-tgv-train-enters-service-1981

ran at 350 kilometers per hour in the year 1991.[6] Today, high speed rail systems exist across the globe, including in China, Indonesia, Uzbekistan and South Korea.

While high-speed rail systems have existed for close to 100 years elsewhere, train-sets in India have had a 100-year history too. The first ever Electric Multiple Units (EMUs) were introduced in the Bombay suburban system in 1925.[7] These EMUs were extended to Madras in 1931 and to Calcutta in 1957. The induction of train-sets into non-suburban systems happened steadily since the 1980s. First, in the Calcutta Metro in 1984[8] which was the first operational Rapid Transit System in India and then as Main Line Electric Multiple Units (MEMUs) for semi urban areas and as Diesel Electric Multiple Units (DEMUs) in the late 80s and early 90s. At the turn of the century, the Delhi Metro introduced Metro train-sets, which became the path breaker for Metro systems in all Indian cities. All these train-sets were used for short distance operation and mostly for intra-city operations with maximum speeds ranging between 80 Kmph and 100 Kmph.

In a formal sense, the idea of Vande Bharat found its way into the policy programme of Indian Railways in 2009. The Vision-2020 document which was formulated in the year 2009 envisaged the use

[6] https://www.railway-international.com/news/43215-thirty-years-ago,-on-may-29,-1991,-six-ice-1-trains-converged-in-kassel-wilhelmshöhe-

[7] https://www.irfca.org/articles/electric-1.html

[8] https://mtp.indianrailways.gov.in/view_section.jsp?lang=0&id=0,1,334

of train sets for intercity services. The document stated that "train-sets should be introduced for intercity express train services to achieve high speed and to minimise terminal detention."[9] In the meanwhile, LHB coaches with a speed potential of 160 kilometres per hour, were gradually inducted from the year 2003.[10] So, with the knowhow on manufacturing LHB coaches being available and the decades long experience of manufacturing train-sets for short distance operation, the stage was set for manufacturing a high-speed, train-set for intercity operation. Owing to the commitment and creativity of the team of engineers from the Integral Coach Factory (ICF), Train-18 happened-much before the envisioned timeline!

Induction of Intercity Train-sets as Vande Bharat

In the wake of the successful trials of Train-18 whose faster acceleration and capability of running at speeds beyond 160 kilometres per hour were proven, expectations were running high. In order to optimize the advantages of the technological advancement, a unique scheduling method was adopted. For the first time, a daytime, intercity train service was planned between two cities located as far away as 760 km. As the train had to leave in the morning and return in the evening, it had to be given the dominant right of way. So, the scheduling method adopted was to chart the fastest path between the origin and destination (OD) points to bare

[9] Indian Railways -Vision-2020 Document, P. 59
[10] Indian Railways - Year Book 2005–06

running time. The conflicts with existing trains were then resolved with least possible impact due to precedence given to the new train. Stoppages were restricted to the bare minimum to ensure that the new train had the fastest transit time between those OD points.

Charted in this manner, the first ever self-propelled intercity train-set with 16 fully air-conditioned cars was introduced, under the nomenclature of "Vande Bharat" on 15 February 2019, invoking a sense of national pride. This train covered the distance between Varanasi and New Delhi in eight hours at a commercial speed of 95 kilometres per hour. It was faster than the next fastest train by three hours and ten minutes in one direction and three hours and thirty minutes in the other. Since then, 67 more pairs of Vande Bharat services have been introduced at rapid pace, after the interlude caused by COVID-19. All these services have been introduced as new and additional services with two scheduling principles, namely, that the train had to be the fastest on the sector, and the stoppages were to be as few as they could be.

Brand Vande Bharat and its Advantages

Several operational advantages ensued. The train-sets could be returned from the destination within half-an-hour as no detachment and attachment of locomotives was involved. This resulted in faster turn-round at the terminal. The second major advantage is the faster acceleration -- with the train-set picking up the speed from 0 to 100 kilometres per hour in 52 seconds. The newly designed driving cab provided an unfettered view of the signals and tracks to the loco-

pilots. Coupled with higher speeds and faster acceleration and deceleration the loco-pilots have been at ease in adhering to the exacting schedule. For conventional trains, separate locomotive links are prepared so that they reach their respective sheds for inspection and scheduled maintenance. With train-sets, the need for a separate loco link or schedule for locomotives has been obviated. Among the other advantages for the operating staff is the effective communication between the loco pilot and the guard of the train, which result in efficacy in starting and stopping the train.

With Vande Bharat services having the fastest transit on each OD pair, with their high percentage of right time arrivals, with the passengers experiencing best-in-class amenities and with an agreeable ride quality --- they were clearly a cut about the rest of the services offered by IR. Given these merits, IR has been successful in branding this product effectively and positioning it as a symbol of India's aspirations for modern and efficient rail travel. Therefore, there has been a clamour for the Vande Bharat rail journey experience among the travelling public, especially among Non-resident Indians and foreign tourists. Thus, the Vande Bharat brand, in turn, burnished the brand image of Indian Railways.

Some Critical Concerns

With all the inherent advantages, the advent of the Vande Bharat Services marked a major milestone in the evolution of passenger services on Indian Railways. Then again, IR has to be wary of the impact these services are likely to have on the system, particularly

because of the manner in which this rolling stock has been rolled out. The concerns relate to the shutting out of the non-AC traveller; the meagre payload and occupancy of these trains; the introduction of the trains as new and additional trains on a super saturated network; and the sub-optimal utilisation of expensive rolling stock due to inspection and maintenance patterns. These concerns and challenges are discussed in the ensuing paragraphs.

Drastic Fall in Lower-class Passenger Traffic

The first concern relates to the disproportionate emphasis on air-conditioned services at the cost lower class traveller. Historically, a constant feature of class-wise analysis of passenger traffic has been the preponderance of the second-class traveller. Even today, over 90 per cent of the non-suburban users travel by either the second class or the sleeper class. The upper-class users, including those travelling by all air-conditioned classes, constitute a mere 10 per cent.

Number of Passengers Originating - Non-Suburban [11] ***(in millions)***				
Year	**Upper class**	**Second Class**	**Total**	**Lower Class Percentage**
1950-51	25	847	872	97
2010-11	100	3,490	3,590	97
2022-23	268	2,336	2,604	90
***Second Class includes Sleeper Class**				

[11] *Indian Railways Year Book 2022-23*, page 21.

Yet, over the years, the upper-class air-conditioned travel has been accorded priority. This is evident in the growth of passenger coaches. In the last 10 years, the capacity to carry air-conditioned class passengers increased by 190 per cent, while the second-class passenger carrying capacity increased by a meagre 15 per cent. This slower growth in supply of lower-class seats is often taken as a proxy for reduction in demand for such travel.

Class wise Capacity in Berth/Seats holding (in 1000s)[12]				
Class	2012-13	2022-23	Increase	Percentage
Air-conditioned Sleeper (2A+ 3A)	411.7	1,194.09	782.39	190
Air-conditioned Chair Car	72.8	108.51	35.71	49
2nd Class	2961.9	3,417.24	455.34	15

The consistently lower priority given to the capacity of the second class and the sleeper class and a corresponding increase of the share of upper-class airconditioned coaches does not consider the fact that low-cost airlines have been providing an accessible alternative mode of travel to the upper-class passenger on most of the sectors. Travellers who can afford only lower-class travel do not have an alternative mode, especially for long-distance movement. This

[12] Indian Railways Annual Statistical Statements 2022-23, Ministry of Railways

constraint on the mobility of the lower-class travellers is likely to have an adverse impact on livelihoods. It is disconcerting to note that IR carried one billion passengers less -- in the lower class, non-suburban segment -- in the year 2022-23 as compared to 2011–12. The proliferation of fully air-conditioned Vande Bharat services, which exclude the non-AC traveller, will worsen this pattern.

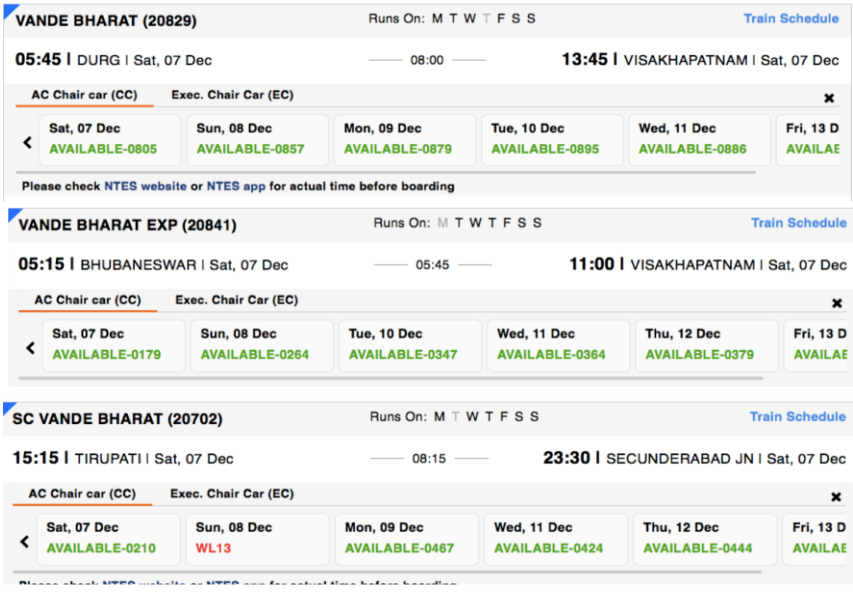
Payload and Occupancy

The second concern relates to payload and occupancy of Vande Bharat services. As mentioned earlier, 68 pairs of Vande Bharat services are operational today.[13] These services are operated with 16-car train-sets. The standard 16 car train-set composition has 1128 seats. The conventional train operated with LHB coaches, on the other hand, has seats and berths exceeding 1500 as per designed capacity. As compared to the standard Vande Bharat train-set, the conventional trains, therefore, have a capacity which is higher by 35%, even without including the dense crush load in unreserved coaches, At present, reportedly, 51 of the 80 Vande Bharat rakes in operation, that is 65% of the trains, are being operated with just eight cars. As compared to the 8-car train-set, the conventional LHB train has an additional capacity of over 1000 seats. Clearly, the Vande Bharat services have lower carrying capacity. When one factors in

[13] https://economictimes.indiatimes.com/industry/transportation/railways/govt-says-136-vande-bharat-train-services-operational-across-railways-network/articleshow/115770665.cms

the actual occupancy of these services, the scenario gets even more curious. Sample data of availability of seats obtained one day before departure is given below. While Vande Bharat trains are generally popular, several of the Vande Bharat services are running with low occupancy levels.

Chart: Availability of seats in select Vande Bharat trains a day before scheduled departure[14]



In this backdrop, it necessary to recall that most of the conventional trains are running with maximum trailing load, with overcrowded unreserved coaches and with reserved classes booked to capacity.

New Trains on Congested Routes

The third concern relates to operating these sub-optimal payload

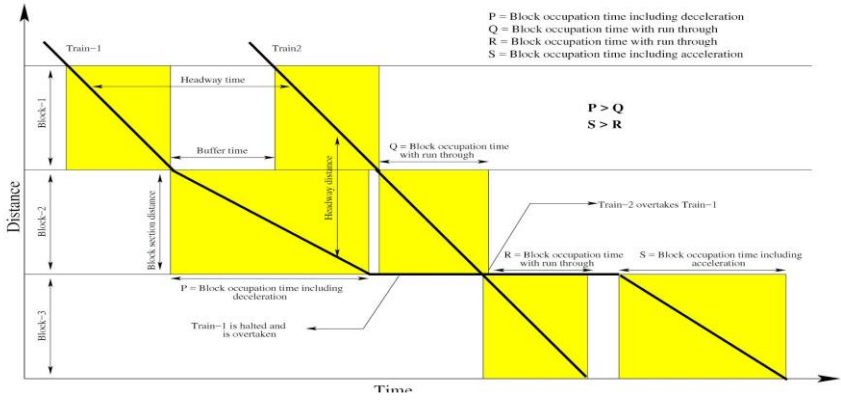
[14] Compiled from https://www.irctc.co.in/nget/train-search

services as new and additional drains on saturated sections of IR. It is common knowledge that line capacity available to introduce new express train services is finite and constricted. All the Vande Bharat Services are new and additional services (not replacement of existing services) introduced on High Density Network (HDN) and Highly Utilised Network (HUN) sectors which are saturated.[15] The National Rail Plan notes that 80% of the HDN and 76% of the HUN are highly congested, requiring line capacity enhancements. For this reason, IR has a continuing programme to augment the capacity on these sectors in terms of the National Rail Plan. The HDN and HUN sectors operate a heterogeneity of services –different categories of express trains, stopping passenger trains, freight services, etc., --- with substantial speed differentials caused by the type of rolling stock used and the number of commercial stoppages. The Vande Bharat services have the predominant right of way on these sections and have to necessarily overtake trains with lesser speeds and more stoppages, leading to an adverse impact on the system. That efficient scheduling principles prescribe avoidance of overtakes for each overtake leads to inefficient use of line capacity is axiomatic (refer to the chart below).

Chart showing headway distance, headway time, and overtake of Train 1 by Train 2[16]

[15] *National Rail Plan 2030* (Draft Final Report, Vol 1.), pages 26 and 28.

[16] Rangaraj, N. and Belur, M. 2018 *A concept note for railway timetabling to rationalize and improve capacity utilization*, Indian Institute of Technology, Bombay. NITI Aayog Concept Note Page 4.



This point was highlighted by the CAG too in Report No. 22 of 2021 too:

> "there are 14 different average speed groups of trains in NDLS - HWH route. The present practice of the faster train overtaking the slower one is consuming the line capacity. Each precedence results in a loss of about 15 minutes running time along with commensurate loss in sectional capacity."[17]

If a train has to overtake another using up resources, the train with higher priority better be one running with full trailing load. Operation of Vande Bharat Train-sets as new and additional services with woefully low trailing loads and sub-optimal occupancy on congested routes would affect freight traffic and put needless pressure on the system. Sub-optimal usage of resources is a failure that merits denunciation as it is has the potential to topple all of IR's successes, if it is left without remedy.

[17] Report No. 22 of the **Comptroller and Auditor General of India. 2021.** page 47

Need for Innovation in Maintenance Pattern

The last challenge relates to achieving the most advantageous utilisation of precious assets. The Vande Bharat train-set costs approximately ₹120 crores[18], which is more than twice the cost of a conventional LHB train, including the locomotive. Yet, the Vande Bharat train sets are being operated only on six days a week. Operated as daytime, intercity expresses, these trains are being taken to the maintenance line for inspection every night. This is in addition to the weekly maintenance schedule. Several conventional trains are maintained at night tapping the availability of modern, high-intensity lighting systems. Evidently, for Vande Bharat services, there is a mandatory daylight maintenance requirement owing to which the rolling stock remains unutilised one-seventh of the time. Rolling stock engineers have to bestow attention to this aspect and extend the innovation to maintenance practices so that the commercial usage of the train-set can be extended to all seven days of the week.

Moving Ahead

To sum up, Vande Bharat is a veritable vision come true. What with the aesthetic appeal and all the multiple operational advantages, IR's rolling stock engineers deserve unqualified commendation for the manner in which intercity train-sets have been envisioned, designed,

[18] https://www.financialexpress.com/business/railways-vande-bharat-express-trains-gain-international-appeal-heres-why-foreign-buyers-are-interested-in-indian-railways-semi-high-speed-train-3624475/

developed and rolled out. While getting the best out of a product of pride, IR needs to be watchful. As the number of services increase and the challenge of sustaining quality surfaces, IR should formulate modules for monitoring the service quality of Vande Bharat – on all aspects including cleanliness, catering and adherence to time-tables. Feedback should be sought from the travellers after each trip for ensuring remedial action and enhancing service quality. What is most important is that IR should step back and look at the shift in priorities that has crept in. IR is grappling with the challenge of resource constraints of which creation of additional line capacity is the most intractable and has a long gestation period. Till then, most of the new Vande Bharat train-sets should be used to replace existing services. All the existing train sets should be augmented to 20 car sets and deployed only on sectors with assured demand. Above all, IR should have a definite plan to include the non-AC travellers who have historically constituted more than 90% of the non-suburban segment. This segment has to be at the centre of an integrated and forward-looking strategy for passenger services on IR. Ignoring these fundamentals may well cause the milestone innovation to become a millstone around the neck of Indian Railways.

Sharat Sahai Mathur
Former GGM, CCO & EA, CRIS & Advisor (MIS) CWC

"The real voyage of discovery consists not in seeking new landscapes, but in having new eyes."

\- *Marcel Proust*

Cyber Physical Systems - their adoption in IR

Background

As per NIST (National Institute of Standards and Technology, USA), "Cyber-Physical Systems (CPS) comprise interacting digital, analog, physical, and human components engineered for function through integrated physics and logic". Cyber Physical Systems consist of cyber (software, firmware components, processors, network devices) and physical (sensors, actuators) components, that interact with one another to produce some desirable result [40].

Cyber Physical Systems are also known as Internet of Things (IoT) based systems or Embedded Systems. However, the generic term used is Cyber Physical Systems (CPS), which encompasses all such systems, whether connected to the Internet or not. In general, in CPSs, data related to specific physical attributes is acquired from physical processes, to be then transmitted, stored, and manipulated using information and communication technologies (ICTs). Optionally, the results of the processing might be fed back to the physical system to actuate physical actuators and get some desirable action.

CPSs are commonly used in the areas of medicine (diagnostics, patient monitoring / critical care, and drug delivery), energy (metering, smart grids), machinery (performance monitoring, predictive maintenance), and transportation (autonomous vehicles, intelligent transport systems).

Conceptually, the architecture of a CPS is composed of three layers, with inter-layer processes connecting the layers together [41].

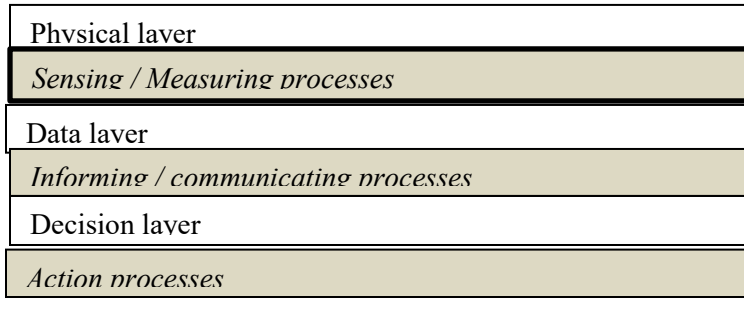


Figure 1 - Layered Architecture of CPS

The Physical layer refees to the sensors, actuators, power supplies, etc. in the system. Sensing / measuring processes convert the continuous signals captured by the Physical layer into digital data that constitutes the Data Layer. Informing / communicating processes carry this data to the computing system to convert it into actionable information. Action processes then enable action to be taken by suitable agents (in many cases, this would be the actuators in the CPS).

A high-level generic logical design of a CPS is as given below. Communication protocols used in these systems is also shown.

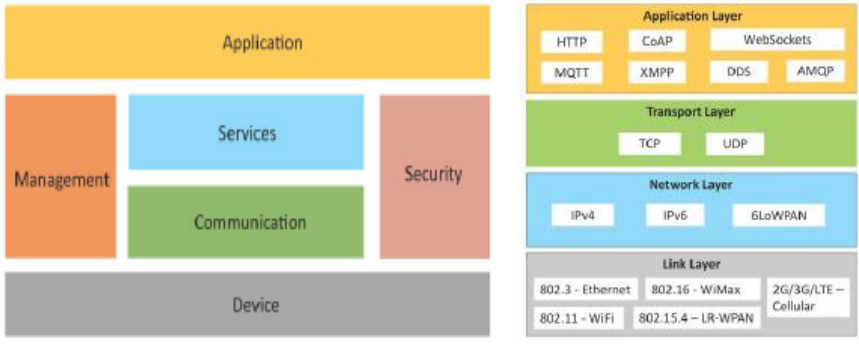


Figure 2 - CPS Logical Design and Protocol options

Areas of adoption of CPS in IR

IR has adopted CPSs primarily in remote diagnostic and predictive maintenance systems. These systems follow the following process:

- Sensing health parameters of equipment
- Communicating health data to central location
- Analyzing health data to provide actionable decisions
- Dissemination of actionable decisions to all concerned

Modern rail vehicles come pre-equipped with in-built CPSs that collect different parameters for diagnostic purposes. For example, various parameters such as location, speed, circuit breaker status, overhead power (OHE) voltage, battery voltage, tractive effort, etc. are captured for locomotives. These parameters, if transmitted from the onboard devices to a central database, and aggregated in an MIS system, can provide valuable information about the running of trains in the system such as overall tractive power demand in an area.

In addition, wayside diagnostic devices are being installed along the Railway track to provide critical condition-related information from

passing trains, such as the condition of their wheels and axles, that are critical for safe running of the train. The installation of these devices has been made a pre-cursor to increase of train speeds in mainline sections of the IR network, which makes it extremely critical.

Similarly, fixed infrastructure such as bridges and track are also provided with sensors to capture the condition of each such asset. Bridges are fitted with load cells, strain gauges, accelerometers, and crack / joint sensors to assess their condition in real time as trains run over them. Alerts can be generated in case of any anomalous condition of the bridge.

CPSs can also be used in innovative ways to monitor the state of health and alertness of train crew, particularly loco pilots (locomotive drivers), whose alertness is critical for safe train running. Wearable devices can monitor various bodily parameters such as heart rate, breathing rate, eye movement, etc. and generate an alert in case the loco pilot's health or alertness level deteriorates.

Lastly, CPSs can also be used to impart training in innovative ways, such as the use of AR / VR (augmented / virtual reality) devices to make training content available at the workplace.

Wayside diagnostics for rail vehicles

In the Indian Railways, wayside diagnostics for rail vehicles are presently derived through the OMRS (Online Monitoring of Rolling Stock) system. OMRS consists of the following components:

- Acoustic Bearing Detector (ABD) gives an early warning on possible defects in the bearing box (axle box), before reaching the stage of hot box.
- Wheel Impact Load Detector (WILD) / Wheel Condition Monitor (WCM) system measures the wheel impact on tracks to identify flat surfaces on wheels in Rolling Stock. This system is based on Accelerometer device to measure the wheel impact.
- Vehicle identification using a visual (photographic) identification technique is used. Alternatively, an RFID reader reads the vehicle identity from a passive RFID tag installed on the vehicle.
- Axle counters count the number of axles to pinpoint the axle / wheel on which the anomaly appears.
- A Train Presence Detector (TPD) detects the arrival of a train and turns on the wayside equipment to conserve power.
- Power supply sources provide uninterruptible conditioned power to the equipment.

In addition to the above devices, the Smart yard project of IR includes inputs from the following devices:

- Hot Box Detector – detects bearing temperatures via an infrared detector
- Machine Vision Inspection System – Vision based inspection system captures images and data of the train Wheel profile, Coupler defects, Hanging Parts, Bogie defects, Body

(underframe) defects, and Brake block/Shoe defects using high speed cameras and laser beams.

The captured data is analyzed to detect defects with the help of different algorithms developed based on standard defect directories, alarm levels etc.

A control plane is used to obtain information about device health across the network.

The architectural considerations that govern the communication networks on the wayside diagnostic devices and systems are as under:

1. Bandwidth
2. Latency
3. Power requirement
4. Reliability
5. Cost

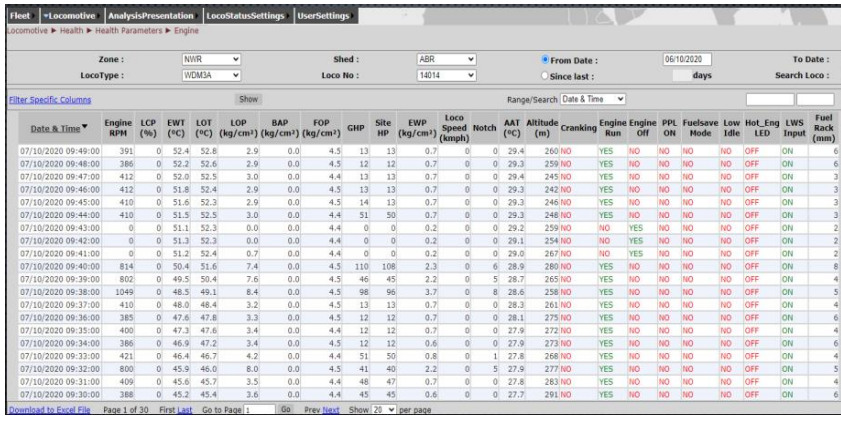
These must be critically evaluated as per need for each specific application. A bouquet of communication services should be available at each location so that the correct mix of network parameters is provided to each wayside application.

Onboard diagnostics in rail vehicles

Onboard diagnostic equipment is placed in all modern locomotives and coaches. The data is captured by the CPS devices and either stored on-board or moved to a central computing facility through a suitable data network.

As mentioned above, electric locomotives are provided with the Remote Monitoring System that captures various operating parameters such as DDS (driver display system), High Voltage, Temperature, Software Version, Isolation etc. are displayed. The Remote Monitoring system collects the status of the locomotive and faults developed in the running locomotive and transmits them to the base station server (Remote Server) in real time on a wireless network along with the location of the locomotive.

Diesel locomotives are fitted with the REMMLOT remote monitoring system that captures parameters such as speed, engine RPM, fuel oil pressure, etc. A sample of typical data captured by this system is shown in the accompanying figure. The data is streamed to a central database through the GSM (cellular) network.


Fleet | Locomotive | AnalysisPresentation | LocoStatusSettings | UserSettings

Locomotive ▶ Health ▶ Health Parameters ▶ Engine

Zone : NWR | Shed : ABR | From Date : 06/10/2020 | To Date :
LocoType : WDM3A | Loco No : 14014 | Since last : days | Search Loco :

Filter Specific Columns | Show | Range/Search Date & Time

Date & Time	Engine RPM	LCP (%)	EWT (°C)	LOT (°C)	LOP (kg/cm²)	BAP (kg/cm²)	FOP (kg/cm²)	GHP	Site HP	EWP (kg/cm²)	Loco Speed (kmph)	Notch	AAT (°C)	Altitude (m)	Cranking	Engine Run	Engine Off	PPL ON	Fuelsave Mode	Low Idle	Hot_Eng LED	LWS Input	Fuel Rack (mm)
07/10/2020 09:49:00	391	0	52.4	52.8	2.9	0.0	4.5	13	13	0.7	0	0	29.4	260	NO	YES	NO	NO	NO	NO	OFF	ON	6
07/10/2020 09:48:00	386	0	52.2	52.6	2.9	0.0	4.5	12	12	0.7	0	0	29.3	259	NO	YES	NO	NO	NO	NO	OFF	ON	6
07/10/2020 09:47:00	412	0	52.0	52.5	3.0	0.0	4.4	13	13	0.7	0	0	29.4	245	NO	YES	NO	NO	NO	NO	OFF	ON	3
07/10/2020 09:46:00	412	0	51.8	52.4	2.9	0.0	4.5	13	13	0.7	0	0	29.3	242	NO	YES	NO	NO	NO	NO	OFF	ON	3
07/10/2020 09:45:00	410	0	51.6	52.3	2.9	0.0	4.5	14	13	0.7	0	0	29.3	246	NO	YES	NO	NO	NO	NO	OFF	ON	3
07/10/2020 09:44:00	410	0	51.5	52.5	3.0	0.0	4.4	51	50	0.7	0	0	29.3	248	NO	YES	NO	NO	NO	NO	OFF	ON	3
07/10/2020 09:43:00	0	0	51.1	52.3	0.0	0.0	4.4	0	0	0.2	0	0	29.2	259	NO	NO	YES	NO	NO	NO	OFF	ON	2
07/10/2020 09:42:00	0	0	51.3	52.3	0.0	0.0	4.4	0	0	0.2	0	0	29.1	254	NO	NO	YES	NO	NO	NO	OFF	ON	2
07/10/2020 09:41:00	0	0	51.2	52.4	0.7	0.0	4.4	0	0	0.2	0	0	29.0	267	NO	NO	YES	NO	NO	NO	OFF	ON	2
07/10/2020 09:40:00	814	0	50.4	51.6	7.4	0.0	4.5	110	108	2.3	0	6	28.9	280	NO	YES	NO	NO	NO	NO	OFF	ON	8
07/10/2020 09:39:00	802	0	49.5	50.4	7.6	0.0	4.5	46	45	2.2	0	5	28.7	265	NO	YES	NO	NO	NO	NO	OFF	ON	4
07/10/2020 09:38:00	1049	0	48.5	49.1	8.4	0.0	4.5	98	96	3.7	0	8	28.6	258	NO	YES	NO	NO	NO	NO	OFF	ON	5
07/10/2020 09:37:00	410	0	48.0	48.4	3.2	0.0	4.5	13	13	0.7	0	0	28.3	261	NO	YES	NO	NO	NO	NO	OFF	ON	4
07/10/2020 09:36:00	385	0	47.6	47.8	3.3	0.0	4.5	12	12	0.7	0	0	28.1	275	NO	YES	NO	NO	NO	NO	OFF	ON	6
07/10/2020 09:35:00	400	0	47.3	47.6	3.4	0.0	4.4	12	12	0.7	0	0	27.9	272	NO	YES	NO	NO	NO	NO	OFF	ON	4
07/10/2020 09:34:00	386	0	46.9	47.2	3.4	0.0	4.5	12	12	0.6	0	0	27.9	273	NO	YES	NO	NO	NO	NO	OFF	ON	6
07/10/2020 09:33:00	421	0	46.4	46.7	4.2	0.0	4.4	51	50	0.8	0	1	27.8	268	NO	YES	NO	NO	NO	NO	OFF	ON	4
07/10/2020 09:32:00	800	0	45.9	46.0	8.0	0.0	4.5	41	40	2.2	0	5	27.9	277	NO	YES	NO	NO	NO	NO	OFF	ON	5
07/10/2020 09:31:00	409	0	45.6	45.7	3.5	0.0	4.4	48	47	0.7	0	0	27.8	283	NO	YES	NO	NO	NO	NO	OFF	ON	4
07/10/2020 09:30:00	388	0	45.2	45.4	3.6	0.0	4.4	45	45	0.6	0	0	27.7	291	NO	YES	NO	NO	NO	NO	OFF	ON	6

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Figure 3 - Parameters captured by REMMLOT system

A similar Remote Monitoring Network carries vibration data from axle-mounted sensors on passenger coaches. This data is used for diagnosis of the health of the wheel and bearing (it calculates a

Wheel Health Index and a Bearing Health Index based on the data). In addition, it also calculates a Track Health Index that correlates the vibration data with the associated geolocation data. [42]

The issue of connectivity of the different vehicles constituting a train becomes important when managing the data captured by various on-board devices. A Train Data Bus or Train Communication Network (TCN) is needed to evacuate the data to a central gateway device on the train from where it can move to a central computing facility. The central computing facility can be on-board, or in a remote location, that can be accessed online through a wireless network, or asynchronously by downloading the data periodically onto a portable device and then loading it onto the central computing facility.

There are several alternatives for a TCN. Buses developed for use in automobiles have been used in the past, e.g. those based on Canbus, Flexray etc. However, the accepted standard is the IEC 61375 set (adopted as IEEE 1473 Type T), first developed in 1999, and then updated between 2012 and 2021 (third edition). This comprises individual Consist Networks connected to a Train Backbone to form a Train Communication Network (TCN). It allows flexibility such that Consist Networks can be restricted to one physical vehicle or can span consists of several physical vehicles. These Consist Networks can be based on the MVB (Multifunction Vehicle Bus), CANOpen, or switched technology. The Train Backbone can be based on Bus (Wired Train Bus - WTB) or

Switched technology. The updated standard provides for on-board to ground communication through a router-based or application-layer Gateway to enable data transfer from running trains to wayside facilities. [43]

A Train Topology Discovery Protocol (TTDP) defined by the IEC standard is used to achieve Train Inauguration procedures, i.e. connection of additional vehicles to a train consist.

The standard also defines the application profile for functions belonging to the Train Control and Monitoring System (TCMS) which is accessed by the operator (e.g. train driver, train staff). In addition, Onboard Multimedia and Telematic Services (OMTS) are also defined.

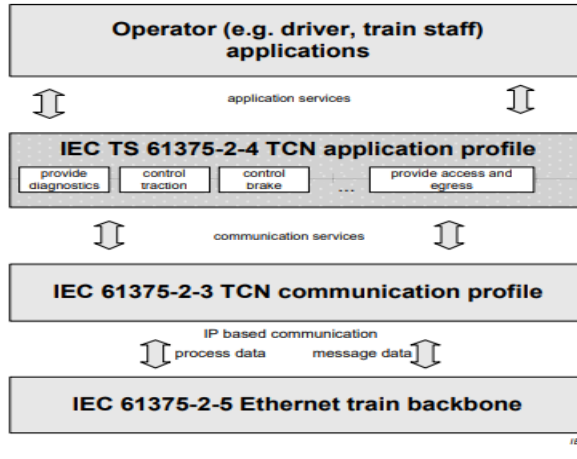


Figure 4 - Application and Communication profiles in TCN

The following list illustrates the wide range of applications that are needed on board running trains. The services mentioned below can be provided through devices and systems connected to the TCN.

a) Operational applications:

- Driver Assistance Application.
- Energy Meter Application.

b) Maintenance applications:

- Configuration data application.
- Monitoring train status (e.g. telemetry).
- Diagnostic data application.
- Event Recorder Application.

c) Multimedia application

- Passenger information application.
- Passenger entertainment application.
- Electronic ticketing application.
- CCTV and video-surveillance.

However, the IEC 61375 standard is suitable only for passenger trains, whether locomotive-hauled or trainsets, because of the need for continuous power to the devices, since Ethernet based communication protocols are used. Freight trains are composed of freight wagons that typically do not undergo the intensive maintenance needed to provide power generators or external power supplies. Devices on these trains would typically have to make do with battery power, which entails using low power communication protocols.

Diagnostics for fixed infrastructure

Track monitoring

Track monitoring is carried out by diagnostic devices mounted onto Track Recording Cars (TRCs) [44]. The TRCs run on different sections of the track to specific schedules and record several track parameters as given below:

- Track parameters such as rail vertical profile, lateral profile, rail alignment, track gauge, cant, twist, curvature.
- Rail profile of both rails to determine vertical, lateral, horizontal, and angular rail wear. Anomalies such as rail roll over (inclination) and lip flow (burring on rail head).
- Video recording of track components to identify defects in rails, sleepers, fastenings, and ballast, such as joint gaps, poor welds, cracked or misaligned sleepers, missing clips and bolts, excess or inadequate ballast, and unwanted vegetation.

Data acquired from the sensors is streamed to an on-board processor for analysis on the fly as well as storage for future analysis.

Bridge monitoring

Bridge Structural Health Monitoring (BSHM) systems monitor aging bridges – they can identify early damage propagation, which may evolve into catastrophic failures. BSHM adopts various sensors, such as cameras, wireless sensors, and radar to better examine bridges.

Bridge structural health monitoring systems encompass the following areas:

- Damage identification including detection, localization, and quantification methods
- Use of Big Data and AI / ML methods in BSHM
- Robotic inspecting systems, use of drones, and digital image processing
- Embedded sensing systems
- Long-term condition monitoring for bridges

In addition, flood level detectors are placed in bridge piers to monitor the level of water flowing under the bridge. It gives alerts when the water level exceeds the danger mark. The system can also detect the rate of water rise and give pre-alerts if the rate of rise is higher than a preset value, even if the water is flowing below the danger mark

.

Imaging of bridge girders and piers using drone-mounted cameras and imaging processing systems are being used to visually inspect hard-to-reach areas of the bridges. Similarly, underwater parts of piers are being inspected using autonomous underwater vessels. [45].

SCADA for Electrical traction power supply

Traction power supply in IR is used to supply power to the Overhead Electrification conductors for running electric locomotives and

trainsets. SCADA (Supervisory Control and Data Acquisition) systems are used to control switching on/off circuit breakers, interrupters at Traction Sub-Stations (TSSs) and switching stations located along the track. They are also used for data acquisition from the field. The most important function is to isolate faulty sections in a reliable manner, and issue alerts to initiate action to rectify the fault [46].

Control is exercised through a centrally located Remote Control Centre (RCC). Presently the system is decentralized and there are 53 RCCs spread across the country. Connectivity is through a dedicated network of data channels accessed through a modem-based network.

Essentially, the system consists of a set of Remote Terminal Units (RTUs) that carryout the actual data capture and remote action. These are connected to a central computing unit in the RCC.

The RTU is a microprocessor-based logic system that accepts digital and analog inputs from the field and acts as a common interface between field devices and the RCC. It receives control commands from the RCC and replies to the RCC.

The entire SCADA system conforms to the IEC 60870 set of communication protocol standards. However, lately, security issues have surfaced for which additional provision are needed.

Modernization of the SCADA systems and placing them under a centralized regime is now becoming important.

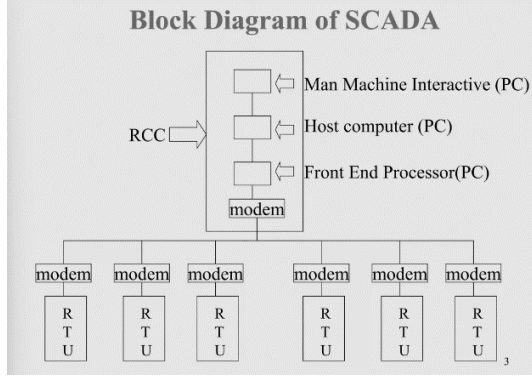


Figure 5 - SCADA system for IR's Traction Power

Signalling

Signals are extremely critical for safe Railway operation. A single malfunctioning signal can cause delays across the entire network. In the worst case, undetected malfunctioning signals can lead to serious accidents.

Presently Indian Railways uses trackside signalling systems. The signalling system thus consists of distributed assets with sensitive and sophisticated equipment, affected by heat and cold, dust, power conditions, and electromagnetic interference, that is exposed to harsh environmental conditions.

This is coupled with the increasing train speeds and traffic density, rapid changes in technology, inadequate skills, and the need to contain costs. Hence the critical need for effective identification of incipient signalling failures and diagnosis of failures when they occur.

Remote condition monitoring systems for signalling systems monitor the health of:

- Signal lamps – incipient failures are particularly monitored
- Point Machines that set points on the track (i.e. switch the track to change train direction)
- DC track circuits and axle counters – track circuits and axle counters enable correct setting of signal aspects, as well as providing warnings in cases of train parting etc. Detection of incipient failures in these devices can prevent serious repercussions.
- Batteries and integrated power supplies that provide power to the signalling equipment in the field

Signalling and train control are already moving towards software enablement with the use of Solid-State Interlocking or SSI, in which the track layout is programmed in the firmware. These systems are moving to CPSs worldwide, in which the entire interlocking system for a particular location is written into software and run off a general-purpose computer. Such software must undergo rigorous quality control as per SIL 4 (Safety Integrity Level 4 as per IEC 61508 - "Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems").

Lastly, the conversion of standard signalling systems to Communications Based Train Control (CBTC, similar to the ETCS – European Train Control System – levels) will involve the large-scale installation of complex CPSs, that will, in the long term,

converge with IR's overall IT architecture.

Conclusion

The above discussion brings out the importance of CPSs in various critical areas of Railway operation. Some of the aspects that concern the Technology Architecture are given below:

Communication network

A suitable communication network for evacuating data from the devices to remote computing facilities. Comprehensive geographical coverage and standardized network components would ensure quick and inexpensive deployment of different CPSs, while keeping costs to manageable levels. A combination of low power WAN technologies (LP-WANs), cellular networks, 5G (when available), satellite channels (e.g. S-band low-bandwidth channels) could form a bouquet from which appropriate components could be selected.

Standardized architecture components

Architecture components to enable low power systems that can run on batteries, perhaps augmented with solar power for sustainability later. A system of edge power supplies could be standardized.

Edge datacentres

A structured system of edge datacentres to house the edge computing devices needed to process the sensor data received from the various CPSs.

Prof. Dr. Veni Mathur
Vice Chairperson Education & Training CILT

"A smooth sea never made a skilled sailor"
- Franklin D. Roosevelt

Unleashing India's Maritime Potential: The Imperative for Port Sector Growth-Public-Private Partnership

In the dynamic world of infrastructure development, public-private partnerships (PPPs) for India's ports sector have been pivotal in the country's journey towards becoming a developed economy. This transformation is part of a broader government focus on mega-infrastructure projects under initiatives like 'Make in India' and the Production-Linked Incentive (PLI) scheme, aimed at enhancing India's role as a global manufacturing hub! In other words, PPP has enabled development of new port infrastructure and efficiency in operations, which were erstwhile considered the domain of the Government, attracting the private sector investment for state-of-the-art facility, making Indian ports globally competitive.

As India's economic aspirations soar to become a USD 30 trillion economy in line with the Viksit Bharat 2047 vision, the need for a robust and efficient port sector has become imperative. The country's trade has witnessed significant growth, key corridors such as India-Africa, India-UAE, and India-China registering substantial increase. For instance, the trade corridor between India and Africa has seen a spurt in trade volumes, growing by 12% per annum over

the past five years. Similarly, trade with the UAE and China has shown consistent growth, contributing significantly to India's economic expansion. Thus the initiatives like 'Make in India' and PLI (Production Linked Incentive) schemes have highlighted the urgency for reforms in this crucial infrastructure domain. While progress has been made in recent decades, a more comprehensive overhaul is required to propel India's port sector to the forefront of global competitiveness.

The benefits brought by private sector participation in ports are not as visible as for other infrastructure projects like airports or railways but stakeholders within the industry acknowledge the contribution. Since the late 1990s, when the Jawaharlal Nehru Port Trust (JNPT) was awarded the first terminal contract to the private sector, there has been a significant shift towards PPP models with current privatization of major ports at 51%. GOI and MOPSW have been focusing and targeting to award 100% terminals under major ports on PPP model.

Post liberalisation in the 1990s, the number of projects under public private partnerships (PPP) in India have increased exponentially, with a view to redefine performance through capacity augmentation, efficiency and productivity enhancement as well as increased competition. Subsequently, the port privatisation programme was flagged off in India in 1997, which, apart from the aforementioned

dynamics, also saw the infusion of fresh funding – including foreign investments - in the ports sector. Nhava Sheva International Container Terminal (NSICT) at JNP, Maharashtra, was the first terminal that was developed on PPP basis. Table 1 provides a glimpse of the current PPP projects in the ports sector.

Table 1 :

Number of PPP Projects at Ports (Excluding Captive)*

Status	Number of Projects	Total Project Cost (In INR Crore)
Pre-Construction	15	34,003
Under-Construction	45	58,140
Operation and Management	48	42,7011
Terminated	14	34,844
Total	122* (as of Dec 2016)	

Source: www.pppindia.org

Statistics highlight the robust contribution of PPPs to the port sector, with nearly 86 projects worth Rs 55,000 crore initiated over the past 25 years. Under the Sagarmala Programme around 123 PPP projects have been identified with a huge investment of Rs.2.63 crores; of which 29 PPP projects are complete another 31 PPP projects worth Rs. 50,942 crores are underway and the rest in various stages of

planning process. The MOPSW is also looking at developing 81 PPP projects by the end of 2024-25 at a colossal cost of Rs. 42,300 crores. These investments have been directed towards a range of developments, including berths, terminals, mechanization, and the development of oil and container jetties. Currently, approximately 57[19] percent of cargo at major ports is handled via PPPs, a figure expected to rise to 85 percent[20] by the end of this decade. India's merchandise EXIM trade has surged, crossing the $1 trillion mark annually, a significant increase from $90 billion in 2000. The port sector has supported this growth trajectory by developing infrastructure to bring in efficiencies through upgrades and capacity enhancements, facilitated by private sector involvement.

Current PPP Scenario In India: Presently, there are 12 major ports in India (six each on the east and west coasts) - under the jurisdiction of the central government - which are governed by the Major Ports Act, 1963 and around 180 non-major ports governed by state governments under the Indian Ports Act 1908. Of the latter, only 60 are reported to be operational. The difference in approach in commissioning PPP projects at both major and minor ports has been summarised in Table 2.

[19] https://pib.gov.in/PressReleasePage.aspx?PRID=1842587
[20] https://pib.gov.in/PressReleasePage.aspx?PRID=1842587

Table 2:

Comparative Assessment of PPP Projects at Major and Minor Ports

Sl. No.	Parameter	Major Port	Minor Port
1	Typical Nature of PPP	Terminal Development and Operation	Development of Green Field Ports
2	Bidding Methodology	2 Stage Bidding-RFQ and RFP	Bidding/Nomination
3	PPP Model	Revenue Share	Revenue Share per MT Royalty
4	Tariff Regime	Royalty Regulated by Tariff Authority for Major Ports (TAMP)	No Regulator
5	Cargo Guarantee	Minimum Guarantee Throughput (MGT) Required	MGT Not Required
6	Concession Period	30 years	40 years
7	Financial Close	180 days	20 days

The government has employed different PPP models like Build-Operate-Transfer (BOT), Build – Own – Operate - Transfer, Build – Own - Lease - Transfer, Design - Build- Finance – Operate - Transfer (DBFOT), and Landlord Port models; wherein the port authority acts as a regulatory body while port operations are handled by private players.

In the Landlord Port model, port authority acts as a regulatory body while private companies operate the terminals. For example, JNPT became the country's first landlord port last year, with its terminals being managed under PPP by private operators. This is the most preferred approach as it enables efficiency through division of roles;

where the port authority focusing on strategic planning, development, and regulation, and private operators bring in operational expertise, modern equipment, and efficient cargo handling capabilities.

Other PPP variants are the BOT and DBFOT model, where private entities are granted concessions to finance, construct, operate, and maintain port facilities for a specified tenure, after which the assets are transferred back to the public authority. The Western India Shipyard Limited (WISL) operated a ship repair facility under the BOT model while Ennore Coal Terminal was developed under the DBFOT model to handle coal imports for power generation. These models too have facilitated the rapid development of port infrastructure, leveraging private sector capital and operational efficiencies.

The government envisions the port sector playing a pivotal role in supporting India's economic advancement over the next 25 years. In the post-COVID geopolitical landscape, with a noticeable shift towards a 'China plus one' strategy by developed nations, India aims to capitalize on this opportunity, especially due to its strategic advantages of proximity to global markets and trade routes. This ambition will involve a substantial expansion of the nation's port infrastructure to enhance cargo handling capacity from the current 2,600 million tonnes per annum (MTPA) to 10,000 MTPA by 2047[21].

[21] https://shipmin.gov.in/sites/default/files/Maritime%20Amrit%20Kaal%20Vision%202047%20%28MAKV%202047%29_compressed_0.pdf

A study by the World Bank found that PPP port terminals in developing countries achieved an average reduction in operating costs of around 20-40%[22] compared to publicly operated terminals. The study also quoted about the success of India's PPP model due to timely changes in the policy and institutional initiatives, speeding up the clearance processes and providing funding assistance for port-led development; taken up by both the central and state governments.

PPPs offer numerous advantages, including the infusion of private capital, operational efficiencies and technological innovation, which are essential for scaling infrastructure capabilities. However, challenges in the PPP model, such as contractual rigidity and short lease periods, can hinder long-term planning and investment. PPPs often involve lengthy and complex contracts that can be inflexible when adapting to unforeseen circumstances or technological advancements. This rigidity can discourage innovation and make it difficult to optimize operations over time. To attain higher growth trajectory some of the critical success factors in PPP models could be – creating a clear vision and strategy for allocation of risks and responsibilities, duties and obligations defined with step by step implementation, monitoring and follow up procedures providing transparency and accountability of all the parties concerned. In the early stages the PPP model had no Model Concession Agreement, later the current norm of 30-year leases was considered adequate to meet the concerns of the government and the private sector;

[22] Public Private Partnership (PPP) for Ports Development and Operation

however, as markets have evolved and competition has increased, there is a need to extend these lease durations to 50 or 60 years. Longer concessions are crucial for enabling substantial capital infusion, capacity development, and providing flexibility to overcome business cycles and uncertainties. In addition, longer leases provide stability and a reasonable assurance of return on investment, encouraging strategic investments in infrastructure development. In conjunction with longer port concessions, the government must ensure certain guarantees in the form of funding shortfall, minimum service fees, flexibility in rules and regulations, all of which protect the private investors/bidders in case of policy changes in the future.

Given the present government's emphasis on port-led development, and ensuing plans for commissioning ambitious projects such as Sagarmala, inland waterways and smart port cities, attracting private investments becomes imperative. However, reported cases of terminal operators going into litigation with port authorities have increased over the years. Apart from this, failure of the current PPP model to remain flexible vis-à-vis changes in regulatory environment and international market dynamics has reduced the number of investors in the sector. Thus, there is a need for re-examination of the PPP scenario in the ports sector in India.

To achieve the ambitious target of port infrastructure development and EXIM trade, an enhanced engagement model is crucial. Several leading international seaports grant significantly longer concession

tenures, ranging from 50 to 72 years. Currently, the average concession period for terminal management in India stands at 30 years, with some recent exceptions offering an additional 20-year extension clause. This falls short of global benchmarks. For instance, PT Pelabuhan Port in Indonesia has been offering terminal management contracts for periods ranging from 65 to 72 years. Other prominent examples include Tianjin Port Shenghan in China (50 years for an oil berth wharf), Poti Sea Port Development in Georgia (49 years for a terminal), Kemaman Port in Malaysia (60 years for the East Wharf terminal), and Saigon Premier Container Terminal in Vietnam (44 years of operational permission).

In response to industry demands, the Government of India now has begun to extend the tenure for operators in the aviation sector. Recently, some privatizations of six airports (Ahmedabad, Jaipur, Lucknow, Guwahati, Mangalore and Thiruvananthapuram) by AAI with 50-year concessions and Multimodal Logistics Parks (under the Bharatmala scheme) with 45-year concessions have been granted. In November 2018, Andhra Pradesh Airports Development Corporation Limited (APADCL) issued an RFP for the new airport at Bhogapuram with concession period for 40 years, extendable by 20 years. Bengaluru and Hyderabad airports (started commercial operations in 2008) were granted concession period for 30 years, with 30 years of extension if requested by the concessionaire.

Since ports are an integral part of transport and logistics system of a nation, extending concession tenures would not only incentivize participation from leading global concessionaires but also

encourage long-term commitments from terminal operators, ensuring all operational units within a port to function in unison for optimal output. Experienced terminal operators bring valuable expertise to operations, ensuring smooth functioning and facilitating knowledge transfer to other stakeholders. There have been many instances where frequent changes in terminal operators have disrupted established operational processes and adversely affect overall port efficiency, creating a climate of uncertainty in port operations. To quote a few examples; Port of Baltimore on the East Coast of the United States experienced notable fluctuations in its operational efficiency due to changes in operators. The transition period of takeover by a new operator was marked by a 10-15% drop in container handling efficiency, which took nearly a year to recover. According to a report by the Australian Competition and Consumer Commission (ACCC) frequent changes in terminal operators at the Port of Melbourne hindered the implementation of long-term strategies and investments, leading to delays in critical infrastructure upgrades and capacity expansions. The Port of Santos in Brazil has also faced challenges due to frequent changes among its terminal operators. A study by the National Confederation of Industry (CNI) highlighted that the lack of continuity in terminal operators has hindered the implementation of long-term operational strategies and investment plans, resulting in inefficiencies and operational disruptions.

Recognizing the successes and challenges within the PPP framework and having set its goals to touch even higher levels in

EXIM and domestic trade, it is crucial for the government to reconsider the contractual terms offered to concessionaires and sub-concessionaires. Aligning these terms with global norms by extending tenures will provide the stability needed for significant private capital investments, thereby enhancing the capacity and efficiency of India's ports as part of a broader strategy to bolster the country's position as a global manufacturing and trading hub. This approach will be instrumental in achieving the projected 300 percent increase in cargo handling capacity by 2047, supporting India's economic ascent to developed nation status.

Recognizing this imperative, the Indian government has demonstrably embarked on a regulatory evolution through the Model Concession Agreement (MCA), the Maritime Amrit Kaal Vision 2047, Sagarmala - these initiatives hold significant promise for the future of Indian ports. The **MCA 2021** aims to enhance the efficiency and attractiveness of India's ports. The provisions include streamlined approval processes, enhanced investment climate, performance-based incentives, and improved risk allocation. These changes have been instrumental in attracting private investments and fostering a more competitive port sector. However, it is essential to ensure that these provisions are being met both by the concessionaire and consigning entities. Developing comprehensive fact-check lists and regular audits can help in maintaining transparency and accountability. The **Maritime Amrit Kaal Vision 2047**, with its ambitious goals, lays a strong foundation for attracting further investment and fostering a sustainable and competitive port

sector. The **Sagarmala** initiative has given significant impetus to this development, focusing on infrastructure development, upgrading existing port infrastructure, and developing new ports to handle increased trade volumes, as well as streamlining logistics to reduce costs and improve the turnaround time for cargo. The **National Logistics Portal (Marine)** is another significant step towards improving India's maritime logistics. This digital platform aims to facilitate trade by providing a single-window solution for all maritime trade-related activities and enhancing transparency by offering real-time information and tracking for consignments, leading to better transparency and efficiency. However, to fully unlock India's port potential, it is crucial to move beyond policy-formulation and delve deeper into port transformation. This necessitates seamless integration of global best practices into the Indian context. Here, collaboration between central and state governments becomes paramount. By preparing comprehensive port policies that are regionally relevant yet aligned with national goals, India can truly propel its port sector to the forefront of global competitiveness.

One area that demands immediate attention is the concession duration. With several major port concessions nearing their end, such as the Pipavav Port and Karaikal Port in 2028, a comprehensive evaluation of the growing needs of the country is warranted. Concession periods must be aligned with the long-term vision for the sector, enabling sustainable investments and operational efficiency. ***Globally, ports have started granting longer concession***

tenures and have successfully implemented provisions that allow for the co-terminus extension of sub-concession tenures to match the primary concession period. This approach keeps the same terminal operators in place, fostering long-term business continuity and operational stability within the ports to maintain the efficiencies and productivity achieved through the involvement of experienced global operators and avoiding disruptions caused by frequent changes in terminal operators.

Here, ***India can draw inspiration from global best practices implemented in the Ports of Singapore, Brazil, South Africa, the United Kingdom (UK), and the United States (US).*** Singapore's port operations are primarily led by the Port of Singapore Authority (PSA Corporation Ltd), which has extended sub-concession tenures to align with the primary concession periods. Data from the Maritime and Port Authority of Singapore shows that the port's container throughput grew from 33.6 million TEUs in 2018 to over 37.2 million TEUs in 2021. This growth is attributed to improved operational coordination and investments stemming from tenure security. With the alignment of tenures between the primary concessionaire and terminal operators, the Port of Santos has reported a 25% improvement in cargo handling speeds. The Port of Durban in South Africa reported a 10% increase in overall efficiency with quicker turnaround times and reduced congestion after extending tenures for operators. The Port of Rotterdam offers a compelling model, granting long-term leases with the inherent option of extending sub-concessions aligned with the primary

concession. This approach not only incentivizes performance but also provides a stable and conducive environment for private players to thrive. Furthermore, the European Union (EU) Concession Directive serves as a benchmark for transparency and equal opportunities for all operators within the value chain.

Ports in Rio de Janeiro, Los Angeles, New York, Singapore and Santos have successfully implemented performance-based sub-concession extension policies, fostering a culture of continuous improvement and accountability. For example, the Port of Rio de Janeiro has adopted performance-based criteria of container handling time and customer satisfaction rates, leading to a reduction in container handling times by about 15%, besides increased investments in infrastructure reported 20% increase in container capacity. The largest port in South America, Santos, has seen substantial benefits from performance-based sub-concession extensions, which led to investments in modernization, resulting in a 40% increase in operational capacity and the port's throughput increased to around 4.5 million TEUs in 2021, up from 3.8 million TEUs in 2018. The Port of New York, New Jersey, and Los Angeles employ a performance-based approach, focusing on a range of operational and environmental KPIs. The implementation of environmental KPIs in the Port of Los Angeles resulted in a 30% reduction in emissions from port operations. The Port of New York and New Jersey, focusing on a range of operational criteria, led to an increase in container handling speed and container throughput.

Furthermore, it is crucial to benchmark India's ports against global standards in areas such as port charges and average drafts. Many leading international ports have implemented competitive pricing strategies and maintained deeper drafts to accommodate larger vessels, enhancing their competitiveness and attracting more trade. India should aim to adopt similar best practices to position its ports as attractive destinations for global maritime trade.

As India aims to transcend the "trailer stage" and unlock its true economic potential; adopting global best practices in the port sector becomes imperative. However, this process should not be a mere copy-and-paste exercise; instead, it should be a thoughtful adaptation tailored to the local market conditions. The comprehensive legal framework employed by the UK, the performance-based extension provisions in Singapore and the US, and the proactive strategies of authorities in the Netherlands and Australia in rolling out the red carpet for private investment in the port sector are all examples worth considering as the new government in India seeks to propel the economic growth story to new heights. ***Additionally, learning from successful global examples, India should consider adopting policies such as the co-terminus extension for terminal operators along with the primary concessionaire.***

By embracing these global best practices and integrating them into the Indian context, the port sector can undergo a transformative journey as it has set its sight on ambitious maritime expansion with plans to develop six mega ports by 2047 with capacity exceeding

300 MTPA at Vadhavan, Tuna Tekra, Chennai, Cochin, Paradip and other non-major port clusters which will significantly boost its cargo handling capacity. A reformed and revitalized port sector will not only contribute to India's economic growth but also position the country as a formidable player in the global trade landscape. The Indian government must seize this opportunity to unlock the full potential of its maritime capabilities while ensuring a streamlined and harmonized approach across the center and states. ***Like the Logistics Policy, where the central government led the way; creating guidelines and states subsequently developing their own aligned versions, India needs to follow the same pattern as far the Maritime policies are concerned. This will ensure a cohesive and efficient ecosystem, facilitating seamless operations and attracting investments across the country.***

A well designed regulatory policy, implemented with balanced and longer concession periods; PPP can transform Ports in India to a greater level of efficiency and sustainability to meet the future vision of 'Viksit Bharat"!

Dr. Sudhir Kumar Das
Former Visiting Faculty, Techno India, Salt Lake Campus, Kolkata

"What is essential is invisible to the eye"
- Antoine De Saint - Exupery

The Hidden Lifelines: Micro tunnelling Between the Twin Tubes of Kolkata's East-West Metro

1.0 Underground Passages of Life and Safety

Imagine a sleek metro racing beneath the Hooghly River, linking Salt Lake to Howrah in just a few minutes. Now imagine an emergency striking deep underground how would passengers escape? The answer lies in something most commuters will never see: microtunnels.

Running silently between the two main metro tunnels of the 16.5 km-long East–West Metro, these microtunnels are no ordinary utility ducts. Built every 250 meters, they serve as critical escape corridors, allowing passengers and rescue teams to move between tunnels when the unexpected occurs.

Each of these microtunnels is connected to a vertical passenger ventilation shaft, rising to the surface an unsung but essential feature of modern metro safety systems. While the system is a marvel of engineering, it's not without its share of drama. Following a series of alarming geotechnical incidents in 2019 at Bowbazar home to fragile, century-old buildings-Kolkata Metro Rail Corporation

(KMRC) had to abandon three of eight planned cross-passages in the Esplanade–Sealdah section.

I had the opportunity to document these events and present them at the International Geotechnical Conference (IGC 2023), hosted by IIT Roorkee. The story continues with the last and perhaps most challenging - microtunnel of the project.

2.0 A Building that Stood in the Way

Let's zoom into the heart of Kolkata, to Raja Subodh Mullick Square, once known as Wellington Square. Here, right opposite Hind Cinema, stands an old eight-storey building stoic, yet silently vulnerable. This is where the last microtunnel was meant to pass underneath.

KMRC's engineers discovered that the structure was precariously balanced on a stepped foundation just 1.5 meters deep a relic of outdated building practices. For a high-rise, this was dangerously insufficient. Fearing a repeat of the Bowbazar collapse, KMRC took the bold but necessary step: evacuate all residents before the tunneling work began.

It wasn't just caution it was foresight backed by science and hard-learned experience.

3.0 Engineering in Extremes: How Micro Tunnelling was Done

i) Freezing the Earth

Before you dig under a metro tunnel, you first freeze the ground literally.

KMRC began by conducting soil tests along Nirmal Chunder Street to prepare for a critical operation: artificial ground freezing. This method involves drilling boreholes and pumping liquid nitrogen at - 196°C to stabilize the soil and prevent groundwater from seeping in. The goal: to create a solid, frozen wall of earth strong enough to support the microtunneling operation.

For this, KMRC brought in the Norwegian specialist firm GeoFrost, and Linde was tasked with delivering the cryogenic oxygen essential for freezing. It was a high-stakes operation involving international collaboration, precision engineering and trust in the invisible.

ii) The Soil Speaks

But first, the soil had to be understood. Boreholes were drilled across Nirmal Chunder Street and Subodh Mullick Square. The earth below Hind Cinema turned out to be far less porous than nearby spots, especially the clay-heavy zone under Dr. B.C. Roy Polyclinic.

That was good news. Engineers noted the firmer composition of the soil and carried out extensive grouting injecting it with materials to reinforce its strength. Confidence grew that the microtunnel could be completed without major surprises.

iii) Freezing Time: The Magic of Artificial Ground Freezing

Once the soil was ready, the ground-freezing operation began. Pipes filled with nitrogen coursed through the earth, solidifying it from within. The once-unstable ground became a frozen platform-an engineered ice fortress beneath one of India's busiest cities. With the ground stabilized and water frozen in place, engineers moved to the next phase: connecting the twin metro tunnels to the surface rescue shaft via microtunneling.

iv) The NATM Advantage

Here, engineers used the New Austrian Tunneling Method (NATM) a flexible and adaptive system that monitors rock and soil conditions in real time. Unlike tunnel boring machines (TBMs), which are fast but rigid, NATM allows engineers to respond dynamically to conditions underground. It's a more artisanal approach to tunneling louder, but smarter in difficult geology.

v) Clearing the Decks

As the microtunneling schedule neared, KMRC again showed prudence. From April 22 to April 30, 2024, residents of the high-rise across Hind Cinema were asked to vacate. Strong barricades were installed to keep machinery, pedestrians, and public safety well-separated.

And since liquid nitrogen isn't something, you casually release into the ground, PESO (Petroleum and Explosives Safety

Organisation) clearance was obtained before Linde began oxygen supply for the freezing process.

This was no ordinary construction job it was a logistical ballet, choreographed with scientific precision and public safety at its core.

4.0 The Engineer's Perspective

At 84, I look back with pride. I was among the engineers who helped build India's first underground metro corridor, from Dumdum to Tollygunge, in the 1980s. That line, the 85th metro in the world, has since grown from Dakshineswar to Kavi Subhash, forming the spine of Kolkata's mass transit system.

Today, interchanges at Esplanade and New Garia connect it to the East–West (green), Joka–Eden Gardens (purple), and New Garia–Airport (orange) lines. What was once a distant vision is now a reality beneath our feet.

This article, free from heavy equations and dense jargon, aims to make the fascinating world of microtunneling accessible-even to those reading it over a cup of tea. If it helps readers appreciate the invisible engineering that makes urban life safer, my purpose is served.

5.0 A Global Feat on Bengal's Soil

The East–West Metro is no ordinary line. It includes one of the world's rarest underwater river crossings-beneath the mighty

Hooghly River. At 13 meters below the riverbed and 26 meters below ground level, the train crosses this 520-meter stretch in just 20 seconds.

With that, India joins the elite league of nations that have mastered underwater metro construction.

So the next time you glide through a metro tunnel in Kolkata, remember the icy silence of the microtunnels, the engineers who listened to the soil, and the frozen earth that made it all possible.

Sanjeev Hariharan
Management Consultant

"We shape our buildings; thereafter, they shape us."
- Winston Churchill

Modernisation of Railway Stations

In Conclusion

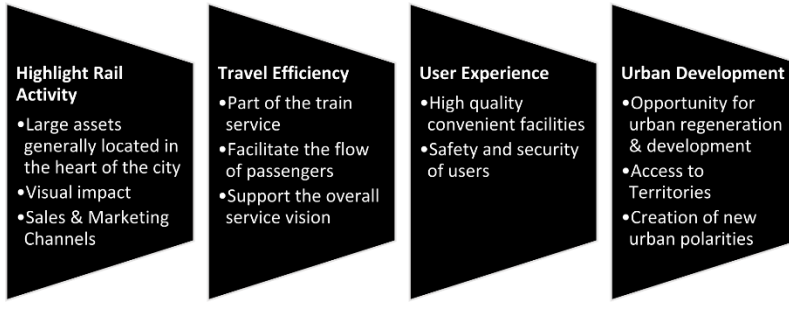
Indian Railways is a network of complex and complicated operations comprising of not just a lengthy grid of tracks and trains, but also a large number of stations. With ever-increasing passenger, the need for more and better well-equipped stations is an imperative. Such a complex system and its design depend on a plethora of factors, including pattern of urbanization, human agglomeration and movement, industrialization and economic impact, and the availability of infrastructure. Any intervention in such complex systems need to be based on a model of sustainability with primary focus on mobility and comfort, rather than relying solely on commercial viability and/or policies. Further, such redevelopment / modernization of Railway Station complex have to be carried out, keeping in mind, not just existing traffic (*passenger*) flows, but also considering future flows and expansion plan/s, if any.

Station building complexes need to be redeveloped in such a manner, that it not only decongests and organizes the existing amenities and facilities, but also creates a landmark development model and a benchmark for other similar developments across the

country. While it may not be possible to replicate the model in totality at all stations, it could set the parameters of development / redevelopment for other stations to follow. This would also ensure a sense of standardization and consistency in identity across the entire railway network.

We had, in the initial sections of this report, mentioned about the Ministry of Railways efforts in redeveloping / modernizing railway stations in India, which forms the basis premise on which the following report has been developed. Based on the findings of this report and a further in-depth analysis and understanding of the issues involved therein, it is felt that the current scheme of redevelopment of the MoR/GoI needs to be further evolved.

The following pages list the summary of analysis of the report on the basis of broad objectives and vision of any Railways network globally, as is depicted in the figure below and suggested action points emerging from them.



Station Development & Planning: Objective & Vision

Phased Redevelopment / Modernization of Stations

As highlighted in the 2nd Chapter[46] of this report, most Railway Stations in India were designed, built and put into operations between the end of the 19th century and the beginning of the 20th century. The infrastructure in these stations are no longer able to cope with the growth in traffic and, in recent years, more and more bottlenecks have formed in the vicinity of the largest conurbations such as Mumbai, Delhi, Kolkata, Chennai, Bengaluru, et al. People's needs and expectations have also changed significantly over time and passengers consider the quality of services to be mediocre.

With the growth of cities, towns and other urban centres around India and with the Indian Railways positioning as a "*means of communication for the poor and the downtrodden*", the focus has been prioritized more towards connecting people, by laying more lines / tracks, operating more trains and/or planning for faster trains. This approach, while it may have a mass appeal, it necessarily does not translate into better image for the Railways, as the quality and/or quantum of services, facilities, amenities and utilities have been found wanting in Railway Stations mentioned herein above. It is Railway Stations in these metropolises be addressed prior to looking at others.

46 Chapter 2: Introduction

Tackling congestion is a priority as crowding leads to chaos, confusion and causes a safety and security concerns[47] A prime example of this was observed during the 26/11 terrorist attack on passengers in the CST Railway Station in Mumbai. Passenger satisfaction can be compromised by crowding and congestion as it reduces mobility, access and comfort. It also results in delays and increased travel times for passengers / goods thereby making rail travel less competitive. All these factors result in affect the bottom-line results, not just financially, but also socially.

Britain's Network Rail embarked on Rail Utilization Strategy (RUS) plan for Stations across the length and breadth of its multi-pronged-multi-layered network, wherein the focus of its redevelopment was on Congestion in and around stations to identify where the problem already existed, and where it was likely to manifest itself in the future. They then developed a toolkit of hierarchy solutions ranging from those with little or no capital cost, to those which required more significant interventions. However, the RUS did not recommend or impose specific solutions for individual stations, as each location had its own unique set of problems. Instead the RUS focused on the potential means to address congestion at stations with more appropriate that tailored solutions developed and implemented at local level, involving all stakeholders in the process, but making use of some or all of the interventions suggested by the RUS. It is imperative to note that the RUS in its recommendations, for

47 Thane Station Complex, Page 21 & Recent Developments at CST Station, Mumbai, Page 41

investigating interventions at stations, considered only those stations that had no committed plans to tackle congestion. As a result stations like London King's Cross, Reading and Birmingham New Street did not appear in the recommendations. The redevelopment of these stations were taken on priority on a stand-alone basis.

ACTION:

- Taking the above in perspective, redevelopment of railway stations need to be undertaken in a phased manner and not implemented simultaneously across the length and the breadth of the country.
- Possible classification methods could be as follows
- Zonal railways and their coverage areas – Indian Railways currently has 16 zones / divisions with their jurisdiction ranging from 2,500 to nearly 7,000 Kms. These zones / divisions could be clubbed to form a 5-6 larger zones of 10,000 – 12,000 Kms each.
- Key Route / Networks – Based on passenger movement, key routes could be determined and identified for station identifications in those routes.
- Cities / Towns – Based on population density of cities, towns & villages currently classified as Major Metros (10 Lakh+), Metros (5-10 Lakhs), Mini Metros (1-5 Lakhs), Class B & Class C (< 1 Lakhs) Towns in Urban areas and villages in Rural areas.

- Passenger Movement – Passenger volumes (including visitors) in stations of cities, towns and villages.
- A combination of the above. It is important to note that there would exist overlapping in the above classifications especially between zones and key routes.
- Focus should be on a few railway stations; preferably the large terminals stations in the major metros and metros and then in phases across mini-metros, towns and so on. This would ensure that a successful model of redevelopment undertaken could be replicated in other stations in the zones.
- Also, as earlier mentioned, standardization and a consistent identity could be developed for a zonal railway network. This would aid in branding, positioning and marketing zonal railway networks and a source of revenue could be developed around such positioning's.
- Major terminal stations could first be redeveloped, as these stations tend to attract the maximum passenger flows. Decongesting and reducing the chaos at these stations would help in streamlining and controlling the operations across other stations in the same network

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- While redevelopment of large terminals in Metros may be taken up on an individual and/or standalone basis, common design, engineering, architectural and implementation plans may be drawn up for other stations in Class B & C Towns and Villages.

2. Station Area Development Scheme – *Facilitating movement, creating better communities and enhancing overall image*

Over the last decade, there has been significant investment in stations across the British rail network. This has included:

- Large-scale investment in the transformation of major stations such as St Pancras, Kings Cross, Manchester Piccadilly, Sheffield and Liverpool Lime Street;
- Investment in stations from specific funds such as the £370 million 'Access for All' programme (making 200 stations fully accessible) and the £150 million National Stations Improvement Programme, which has targeted improvements at the busiest medium sized stations; and
- Significant investment funded by Train Operating Companies and Passenger Transport Executives at many stations.

The importance on pre-planning through stakeholder consultation, as has been emphasized previously, resulted in highlighting several key areas for a larger station area redevelopment such as,

- Removal of physical barriers / constraints impeding passenger and traffic movement resulting from alignment of, and lack of access through some stations. This resulted in a need for complete transformation on one side of some of the stations and indicating the kind / type of investments that are required to make such stations, a destination in their own right. Removal of impediments in certain cases also aided the design / redesign

process in some of the station areas such as location of entrances, drop-off/pick-up zones, parking, etc.

- The development of station areas have increased investor confidence especially with major investments in retail and office space segments resulting in creating more job opportunities. Concurrently, it also demonstrated the scope for leveraging new source/s of funding like levying an additional surcharge / levy on businesses situated alongside some of the stations to create / enhance the business district.
- The perception of stations as gateways and linking their impressions with that of the Town / City has resulted in improvement of overall image. Evidences of the results of such works suggest that these impressions had real impacts on investment and economic development in the cities concerned. Equally, stakeholders with particular responsibility for encouraging investments confirmed that this became considerably easier after the station redevelopment had been completed. Role of stations as gateways is equally important in smaller towns, as it was noted that, as well as attracting a number of regeneration and design awards, the station area regeneration helped local communities to attract several new businesses to the district.
- Lastly, compelling evidence compiled from station redevelopment works undertaken by Network Rail in Britain, suggested that station investments do catalyze a wider

regeneration. In all cases, the station investment was regarded as central to the delivery of the wider scheme, although the scale of the catalytic effect was generally greater in the case of the larger city centre stations.

Overall, redevelopment of railway stations not only enhance the revenue streams of railways through monetization of existing assets, utilities, facilities and services, but also result in creating additional jobs required for handling such utilities, facilities and services.

Multi-modal connectivity [48] : While the key purpose of stations is to provide access to the connectivity offered by the rail network, it is also dependent on other modes of connectivity such as bus, taxis, cars, metros and/or light rail. The extent of availability of these services and the throughput at the point of intersection with the station will travel is as important as range and frequency of services offered by railways. The presence of a trans-modal connectivity will also augment a positive perception of stations and the location they are located in.

ACTION:

- In addition to investments in station redevelopment, focus also needs to be laid on revitalizing surrounding and adjacent areas create more opportunities for businesses to flourish.

48 Multi-Modal Connectivity, Page 24; CST as a Multi-Modal Station, Page 50

- Sufficient connectivity, capacity & inter-linkages with other modes of transport need to be created to enable stations to support sustainable economic growth by helping to accommodate increasing travel demand and constrain private transport use. They can be particularly effective in supporting high density development in the station vicinity, but can also enable a town or city as a whole to grow in a sustainable way over the long term.

- Stations are a key point of arrival and departure for many travelers and other visitors, and the quality of the station environment forms part of peoples' overall perception of a town or city. A high quality, well designed station can improve the image of the location it serves, making it more attractive as a place to live, work and invest.

Holistic Customer Experience

Most railway stations are located in city centers and hence the redevelopment strategies need to be focused on areas extending beyond the building complexes including the approaching roads, streets & by-lanes, vehicular movement (type and scale), occupation and ownership of businesses and residents, commercial offices and other retail establishments including small and medium sized vendors. The pattern and intensity of vehicular movement by time

of day and night is also equally essential to be examined and analyzed.

In the case of the King's Cross Station[49] in Central London, which is also a major transport hub for the city, the focus of redevelopment was on a mixed-use urban regeneration. The lands use mix comprises of Office, Retail, Multifamily housing, Hotel, Parks and open space, Parking and Transport facilities. Located on the site of former rail and industrial facilities, the 67 acre (27 ha) redevelopment involves restoration of existing historic buildings as well as new construction, with the entire plan organized around internal streets and 26 acres (10.5 ha) of open space to form a new public realm for the area. Rest of the area include uses such as 3.4 million square feet (316,000 sq m) of office space, 2,000 residential units, 500,000 square feet (46,400 sq.m.) of retail and leisure space, a hotel, and educational facilities. The site is served directly by 6 London Underground lines, 2 national mainline train stations, and an international high-speed rail connecting to Paris. King's Cross Central is being redeveloped on a new framework and urban structure, one that integrates with surrounding neighbourhoods and communities with an endeavour to (re)connect them. Similarly, in honour of New York's Grand Central Station's centenary celebrations in January 2013, three leading and reputed architects were asked to present their proposed plans on reimagining the iconic

49 Kings Cross Station, Pages 35 and 38

terminal. While contrasting proposed plans ranged from alleviating the Terminal's acute overcrowding to new zoning laws to increase population density, it was the plans proposed and work done by reputed architecture firm M/s. Beyer Blinder Belle work on the revitalization of Grand Central Terminal that transformed USA's busiest train station into a contemporary, multi-use transit and retail hub. Amongst the works undertaken, the first was the Main Concourse rehabilitation, which involved updating building-wide systems, significant revisions and additions to vertical circulation between the Main and Lower Concourse including new escalator banks, and the re-creation of a monumental stair. The Lower Concourse, is now filled with quality food tenants frequented by commuters and midtown workers. The second major work undertaken concurrently, was the retail redevelopment of the Terminal through found space, which resulted in additional restaurants, cafés, specialty retailers, and a food market. A vacant bank building was reused to create a new 43rd Street station entrance on Lexington Avenue that is lined with fresh food stores and recalls the finest European open-air markets; the Hyatt Passageway was transformed into an elegant arcade with handsome storefronts and a variety of shops; restaurants were added to the previously vacant North and East balconies in the Main Concourse; and the passage that originally led to the Incoming Train Room was redesigned to include a café and open retail areas.

While the key focus of the Indian Railway Station Development Corporation (ISRDC) is on developing new / redeveloping existing railway stations for enhancing customer experience, the current scheme seems to be focused primarily on excess and/or available railway lands across the length and breadth of the country and monetizing such lands for commercial gains. Based on Project Information Memorandums (PIM) of several railway stations, it is also observed that the focus seems to be on exploiting real estate potentials, that exist/s in these stations, but the outcome of which will have little or in some cases no effect on enhancing customer experience or passenger comfort. A case in point, on Chandigarh Railway Station[50], explained in detail earlier in this report.

ACTION:

- Redevelopment of railway stations should not be restricted or limited to Station complexes only, but rather should focus on a larger area surrounding stations.
- The MoR needs to relook into the aspect of developing new stations and redeveloping existing stations on a case to case basis and also dwelve in detail on the aspects of development focusing on creating amenities, facilities and utilities for passenger ease, access and comfort on a long-term and futuristic basis, rather than creating architectural face-lifts.

50 Chandigarh Railway Station, Page 54.

- Future scenarios need to be considered while redeveloping stations, as passenger growth is imminent and the need to provide for better services and comfort to them needs to be paramount. The key criterion for this is 'access' i.e. passengers should have easy and uninterrupted access to various services, amenities and facilities including common utilities.
- Places of tourist interests, architectural and heritage complexes should also be incorporated into the area of study prior to implementing a development plan. Implementation of external and internal redevelopment strategies should be dealt with separately, but simultaneously once the action plans are finalized
- Having said this, architectural grandeur of stations, especially those with historical significance should be maintained and any future developments should be in accordance with, and agreement to existing plans. The opulence of such architecture is a sight to witness and embodies the spirt of magnificence, history and landmark. On the contrary, if any, development of surrounding architectures should be styled similarly to ensure a feeling of continuity and stability. The development of CST and its surrounding areas is a case in point.
- Several specific suggestions have been made w.r.t CST Station in Mumbai and the Chandigarh Railway Station.

4. **Coming together, Keeping together and Working together -** ***Beginning, Progress & Success.***

We had earlier in the report, mentioned the importance of success of public-private community partnerships with better coordination between various stakeholders. The benefits of such stakeholder interactions and communication has been best observed in Network Rail's initiative in Great Britain[51].

In the redevelopment of the King's Cross Station in London, Network Rail committed to thorough consultation with the local community and interested stakeholders. They provided members of the public, with an interest in the station, an opportunity to shape elements of their schemes, including local residents, commuters and/or even visitors to London. In addition to public consultation, Network rail also held public exhibitions in the concourse at King's Cross station periodically, talking about the development as a whole and specific pieces of upcoming work that might be of interest. Architectural models were displayed with members of the project team disseminating information and distributing leaflets to interested persons. This resulted in almost 70% of the affected / interested persons expressing their support to the project and providing valuable feedback to the developers.

The King's Cross Place Plan was jointly prepared by Camden and Islington Councils, as the King's Cross area fell in both the council areas. However, the redevelopment programme featured a vast

51 Transportation – Urbanization Interface: An Integrated Model, Page 23; Rail-o-polis, Pages 35-37; Kings Cross Station, Page 38

number of stakeholders directly or indirectly involved with the scheme. Other organization including neighborhood groups, citizen forums, cycling groups, civic management & public welfare committees, and residents & tenant associations. Network Rail also appointed an external firm for overall commercial management supporting their own project management team when dealing with other aspects of the project such as the environment. This appointment of a 3rd party company to provide project management is another example of a multi-stake holder approach which promotes democracy, transparency and accountability.

Three pertinent issues that one needs to address prior to undertaking such projects and adopting a stakeholder approach are:

1. When identifying "needs" in the planning process, it is important to ask, whose needs? In this case, one needs to identify who is the customer / end-user and who are being impacted by the outcome / result of such a (re)development.
2. Secondly, the right strategy would be to take into account the tensions / disputations and interdependence between different several social, economic and political circles, who are being impacted by the development, as also the levels of impact of the effects / consequences of the same.
3. Last and finally, firm decisions and standpoints on oppositions and/or differences in opinions need to be taken in the larger

interest of overall socio-economic development of the overall region.

ACTION:

- A stakeholder approach needs to be instituted prior to initiating the plan. From designers, developers and government agencies implementing the project (in this case being the Railways), other government agencies including Municipal Bodies, Environment, Public Works Departments (Centre & State), Power and Water Agencies, Police and others such Heritage / Historical Society's, Citizens Charters, Business Forums, et al should be consulted prior to initiating a plan.

- In depth discussions and meetings wherein each of the stakeholders should be heard prior to addressing them.

- Further, all the stakeholders should be kept duly informed of the status of the project at every stage of design, development and implementation of action plans.

- Other external firms, industry bodies, individual experts, planners, etc. not directly involved with the project may be involved at various phases of the project, however a central coordination team should be set up to coordinate, communicate

with and disseminate information periodically to all stakeholders.

- Such a stakeholder approach should be incorporated formally as part of the overall redevelopment strategy plan. Such an action would result in forming a healthy and sustainable development without delays in time and cost overruns.

4. Benchmarking - *With the best, for achieving the best.*

In this report, several references have been made to international railway stations, in Europe and America. Redevelopment of Railways Stations is a novel concept inter-nationally and it is only recently that several countries in the Western World such as UK, USA and Japan are looking at this concept. This is primarily because of a huge shift in traffic from more expensive solutions such as air back into the railways. Till a couple of years back, air travel was touted as the preferred means of transport around the world.

With low-cost carriers the suggestion did make some effect on the ground. However, with increasing ATF costs, growing impact of Aviation sector on climate change (Including Engine Emissions, Noise and Fuels, the sector accounts for 4-9% of total climate change on human activity[52]), risks involved and perception of unaffordability for many, the focus has once again shifted to the Rail

sector. Also, with innovative and new-age technologies being infused in the rail sector and hi-speed trains, there is renewed focus on redeveloping railway stations catering to such technologies.

Special focus has been laid on 2 key redevelopments, viz. the Kings Cross / ST. Pancras Station redevelopment in London (UK) and the Grand Central Station Area redevelopment in New York. While the overall redesign and redevelopment strategy and plan has already been put in place with the involvement of several reputed architects, planners and engineering design firms, both the projects are in various stages of completion. However, the overall design & redevelopment strategies also emphasize on the fact that such redevelopment plans are continuous improvement processes with incremental value yield over time. Several research undertaken by Network Rail showed that several stations acted as barriers rather

52 Source: International Civil Aviation Organization (ICAO)

than facilitating growth. It was also elicited from such research how poor station conditions and design and economy of surrounding areas restrict physical access across urban areas, discourages investment and even goes further in creating a poor impression of a town / city. Wherein the focus of Network Rail's redevelopment initiative was primarily on better passenger connectivity, it also aimed to provide capacity of growth and offer several other development opportunities. This has resulted in substantial investments of around £ 3.2 Billion (Approx. US$ 5 Billion or ₹

25,750 Crores) during the period 2010 to 2014. Similarly, the 'Grand Paris Project', a transformation of the greater metropolis in Paris including its prestigious Gare du Nord Railway Station at a cost of approximately € 30 Billion and the revitalization of the Grand Central Terminal, New York and the area surrounding the terminal and costing around US$ 200 Million are other prime examples of station area redevelopment projects. There is also an effort to plan a US$ 10 Billion proposed expansion of Union Station to handle triple the passenger capacity at the station.

Similarly, several rail networks in other parts of the world including France, Japan, Hong Kong, Malaysia and South Africa, to name a few have also embarked on redevelopment of railway stations. However, several of these redevelopment projects are limited to station complexes only as also limited to architectural transformations and /or design restructurings and do not include a larger station area scheme.

Similar to the West, railway stations in India too, have not kept pace with demands of passengers and the prerequisites of urban growth. While several individual projects have been identified and in various stages of implementation, the projects have achieved little or no progress. Also, the efforts are more concentrated on station buildings, rather than on station area developments. The Bangalore City Station redevelopment is one such example, wherein to meet

the ever-growing demand for facilities from the travelling public, a plethora of amenities and services have been created to make train journey a pleasurable experience. Some of the important facilities provided at Bangalore city railway station are, dedicated facility for dispensing reserved and unreserved tickets,

Customer Facilitation Centre and 'May I Help' centre in the main building to assist the passengers, state of the art Food Plaza, which serves multi cuisine food to the travelling public and tourists, battery operated Ferry Carts free of cost for the benefit of differently abled and senior citizen passengers, dedicated waiting rooms for the differently abled, AC waiting lounges, waiting rooms for general and lady passengers, passenger lifts, Foot Over Bridge and escalators for inter-platform movement etc. However, as can be seen, this is again limited to the station building complex only and not a larger area development around the station.

ACTION:

- A Model Railway Station – either on a Greenfield or Brownfield basis needs to be implemented, which can set as a precedent for other stations around the country. This is very essential, as such a development would provide the Railways with insights into various nuances of design and development, communication, marketing and even financing. Stations can support a given level

of passenger throughput before they become overcrowded or, ultimately, reach an absolute constraint. Providing station capacity that supports future demand can therefore have a direct impact on the level of residential and employment growth that a city can sustain. A development of this nature can put in place a sustainable model, which incorporating and testing several innovative methods could be later replicated in other stations.

- It is imperative that several such station area redevelopment schemes around the globe be analyzed for gathering inputs into various areas of design, planning, coordination and implementation including, but not limited to, involving experts, stakeholder consultation, marketing & branding with a view to develop a model sustainable for the future.

- It is also imperative that a team from Railways visit and study these mechanisms in greater detail for effective implementation of similar structure in India.

6. Paradigm Shifts – *PPP, Monetizing Assets & Thinking.*

It seems that there exists no clear roadmap for implementation of PPP in developing Railway Stations by Indian Railways (IR) as yet. A PPP can only be successful if IR can ensure discipline on part of the private player to enforce

the contract and thus result in achieving the desired objective viz. Revenue Certainty. It is not very clear whether IR possesses the requisite skills that such as complex business environment calls for.

This is evident from the fact that there have been a multitude of changes and shifting of responsibilities to authorities monitoring the redevelopment of stations plans – from Zonal GMs initially to Indian Railway Station Development Corporation Limited (IRSDC) to Rail Land Development Authority (RLDA) currently. Also, several initiatives undertaken so far w.r.t Modernization of Railway Stations, have not seen major successes with some not having been commenced and still on drawing boards.

Another reason for the slow approach is probably the fear of emergence of private monopolies (in the place of state monopoly) in case right policies are not adopted. The private sector participation is not a gift without a curse. It comes with its own set of problems. It has historically been proved that inviting of private sector participation in case of a government monopoly has not always led to the private sector efficiencies and modernization. The Road sector in India, is one such prime example, where a multitude of projects are at various stages on non-completion, with some even being withdrawn. On the contrary it has led to monopolization in the hands of the private sector. Therefore it is of pivotal interest that

whenever private sector participation is being talked about it should always be assumed to be inviting competition as well.

While redeveloping and refurbishing railway stations by way of providing better infrastructure, utilities, facilities and services can result in better revenues due to increased footfalls and throughput, monetizing several assets currently owned by the railways, which would result in additional incomes.

Two areas that could be considered as part of the PPP model, are land adjacent to stations and air space over the stations. Indian Railways is already planning to do so by attracting private investments in the area by allowing the areas around the stations and the air space above platform to be commercially developed while operational/passenger – handling areas are separated from such commercial areas as in case of airports. The concessionaire would be expected to construct and maintain the operational and passenger areas free of cost, share the revenue earned from the real-estate created and hand over the same after the concession period.

Altogether 19 stations have been identified at the first stage. These are CST Mumbai, Pune, Howrah (Kolkata), Lucknow, New Delhi, Anand Vihar and Bijwasan at Delhi, Amritsar, Chandigarh, Varanasi, Chennai, Thiruvananthapuram, Secunderabad, Ahmedabad, Patna, Bhubaneshwar, Mathura, Bangalore and

Bhopal. Development of other stations green field passenger terminals would also be taken up in a similar manner. However, an initial project for the New Delhi Station, which was tendered, did not see the light of the day due to numerous hindrances in the PPP model including lack of stakeholder consultative approach, extent of plan envisaged, environmental & heritage obstructions, etc.

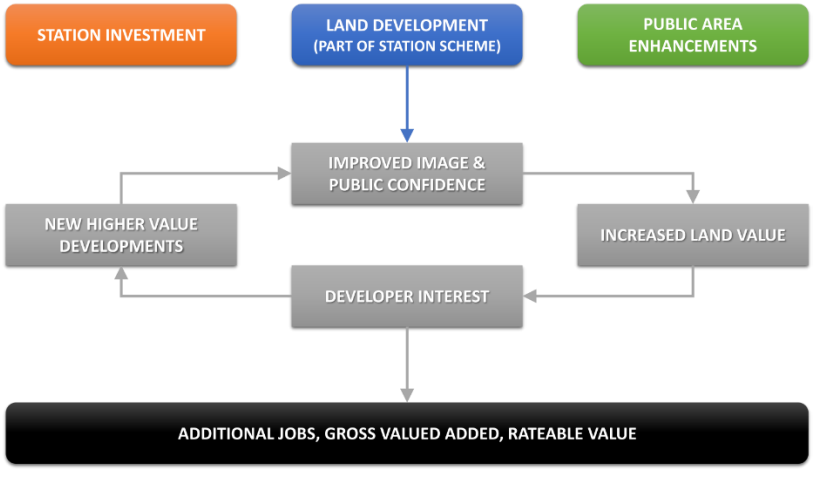
Indian Railways also has approximately 43,000 hectares of vacant land. These are mostly alongside track in longitudinal strips, around railway stations, and in railway colonies especially in metro and other important cities/ towns with potential of being used commercially to generate revenue as well as capital for modernization and capacity addition. An authority, namely, Rail Land Development Authority (RLDA) has been set up under the Railway (Amendment) Act 2005 to pursue, inter alia, the main objectives of generating revenue, up grading railway assets and providing world-class state-of-the art passenger facilities/services at stations.

Monetizing railways assets has been one of the core areas focused in the recently concluded Railway Budget presented by the Hon'ble Minister of Railways. However, Railways need to address the dual issues of finding funds as well as providing a clear plan to private investors of from where the revenue will come from.

ACTION:

- A detailed PPP policy needs to be put in place, highlighting in detail, the areas where investments are invited, the structure and time frames of these investments, model concession and development agreements and a revenue model for each of them. Modern global concepts in PPP, especially in Railways, including penalties for delays and rewards for early completion should be incorporated as part of the agreements.
- Several international PPP models including Concessions, BOTs, BOOTs, DBOTs, etc. exist which may be examined, analyzed and structured suitably to Indian environments.
- The Model Railway Station, suggested earlier, may be put to test on a PPP model, to provide world-class passenger amenities and services to the large multitude of passengers using these stations. Depending on the success and/or impediments faced in the development of this Model, future changes and/or alterations could be made in the PPP agreements.
- Assets such as air space *(over stations)* and land *(owned by IR)* should be monetized for better commercial realization. However, care needs to be taken, that such assets are not converted into random real estate developments, but are related to core operations and functions of railways, which may result in raising more funds.

- Lastly, a paradigm shift needs to be made in the functioning of Railways and its perception. Railways, until now, has been perceived as the 'Poor Man's' transport and to an extent this seems to be a reality. Low fares coupled with less than acceptable customer service deliveries, low efficiency and response, persistent risks in safety and security and low infusion of technology compared to the rest of modern economies in the world, has minimized the overall impact of railways. The focus needs to be on provision of better travel experience to the passenger and reduce the inconsistencies that prevail in the largest public organization in the world.



The Hon'ble Minister, during his presentation of this years' Railway Budget has rightly identified the core issues impeding the growth of railways and has also suggested the right steps to mitigate the same.

He has allotted ₹ 100,000 Crores for the redevelopment of Stations and logistics Parks.

What needs to be seen, in the coming months and years, is the effect of this budget and this can only be achieved, by addressing the critical issues, preparing definitive action plan and most of all implementing them within the time frames estimated.

There is hardly any doubt that Indian railways need transformation… that transformation needs to be done now.

"The backbone of a transportation system of an economy as geographically large, as densely populated, and as resource constrained as India's has to be rail-based. Airways cannot be the long haul mass transportation system, nor can it be the road system. There is nothing as efficient as steel wheels on steel rails for transporting hundreds of millions of people over distances that are of the order of hundreds of kilometers."

Dr. Atanu Dey
Economist
In his book "Transforming India"

Appendix A

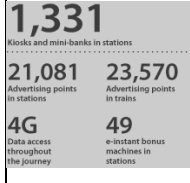
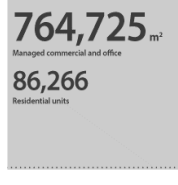
Transit-Oriented Development in Hong-Kong

The development of Hong Kong is unparalleled to anywhere else in the world and as its population continues to grow, mass transportation systems are the 'si·ne qua non' of the city. In spite of the severe geographical constraints on the spatial expansion of the city, the city continues to grow. Effective public transportation has taken root in order to serve the increasing population.

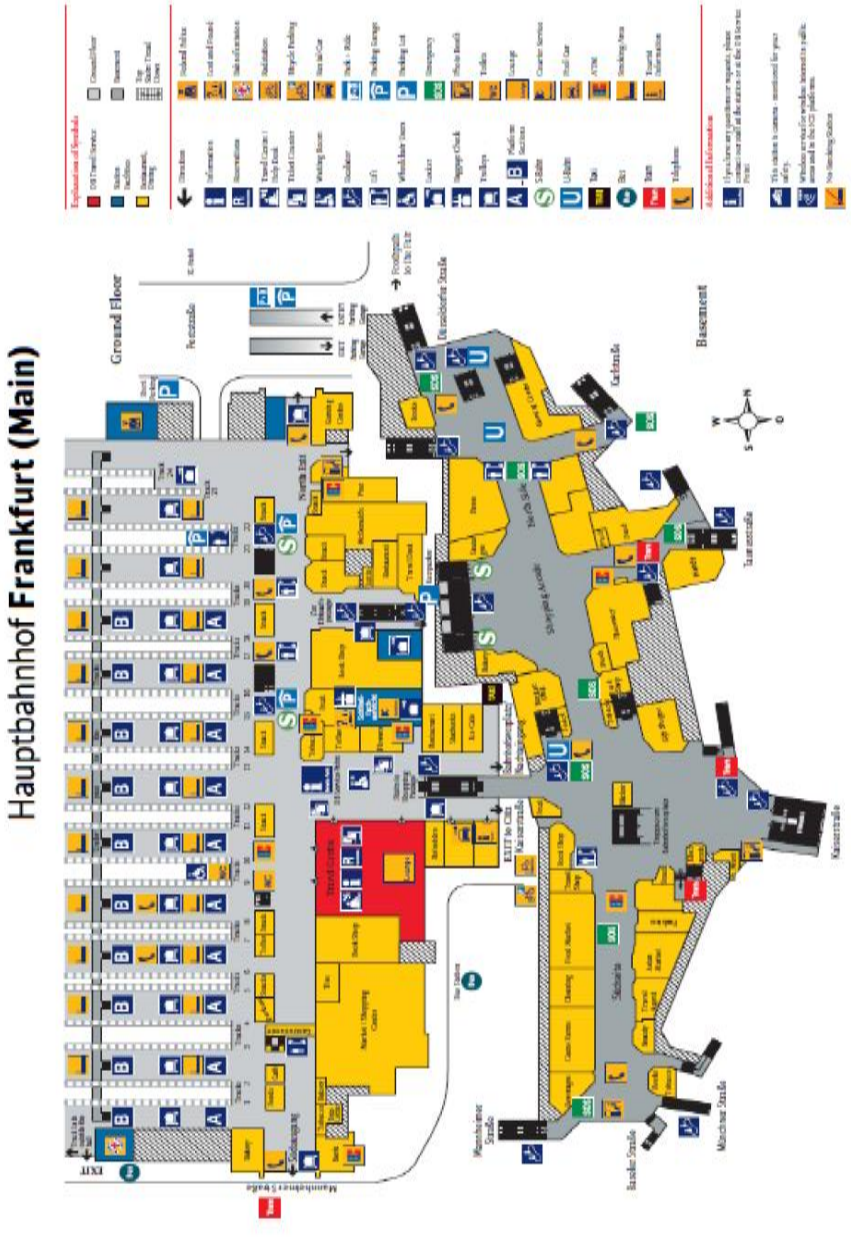
The Mass Transit Railway Corporation established in 1975, opened its first railway line in Hong Kong in 1979. The company, internationally recognized as one of the world's leading railways for safety, reliability and customer service has a track record of building, connecting and growing sustainable communities based on integrating rail transport and property development. This enables the corporation to self-finance their day-to-day railway operations, establish reasonable fares and ensure sustained patronage of the system. The TOD targets high-density living and commercial spaces around network stations and allocates open spaces between hubs that can be used to support green zones and other forms of sustainable development. It encourages social and economic development by revitalizing older areas and establishing new centres of activity.

MTR's main network operations is on 9 railway lines connecting Hong Kong Island, Kowloon and the New Territories, while, a light rail network connects the communities of Tuen Mun and Yuen Long in the New Territories. In addition, a bus fleet provides feeder services, Airport Express connects to the Hong Kong International Airport, and Inter-City services provides connections to Guangdong Province, Beijing and Shanghai in mainland China. In addition to MTR's rail projects, the corporation is also involved in railway construction, operations and consultancy projects worldwide, including the development of residential and commercial projects, property leasing and management, advertising and telecommunications services along the rail lines.

Maritime Square is a four storey shopping centre located on Tsing Yi Island in Hong Kong. It is directly connected to Tierra Verde, a large housing complex. Maritime Square is the first shopping mall in Hong Kong adopting ocean and navigation as the design theme. Occupying a total of 500,000 square feet, the mall houses a superior range of shops and restaurants.

HONG KONG RAIL **Hong Kong Passenger Services** A territory-wide rail network connects passengers to their destinations in a seamless travel experience that links regional centres through a series of local community hubs. The network is one of the most intensively used mass transit systems in the world and is known for its reliability, safety and operational efficiency	**Station Commercial and Rail-Related Businesses** The rail network's stations provide convenient customer services, including retail shopping, infotainment and social amenities.	**Rail Project Construction** Five new rail projects constructed over the next seven years will add approximately 56 km of track to the Hong Kong mass transit network. These new lines promote community growth and provide connectivity to the regional centres of Hong Kong and the Pearl River Delta.
		• Express Rail Link (Guangzhou-Shenzhen-Hong Kong Express Rail Link) (service concession) • West Island Line (owned by MTR) • Kwun Tong Line Extension (owned by MTR) • South Island Line (East) (owned by MTR) • Shatin to Central Link (service concession)
HONG KONG PROPERTY		
Investment Transit-oriented development provides the opportunity for long-term revenue streams accrued through property assets. Securing retail and commercial space above stations provides the additional synergy between network and community. 	**Management** The management of residential and commercial properties positions the company as an industry leader in Hong Kong. We leverage our expertise with contracts in major cities of mainland China. 	**Development** As grantee or agent, we engage professional property companies to co-develop properties in Hong Kong, secured under the rail plus property model. We closely consider societal and environmental aspirations when engaging industry expertise and seek innovation in living spaces and public amenities. 

Appendix B



MINUTES OF THE MEETING OF THE ANNUAL GENERAL MEETING HELD ON 22nd DECEMBER, 2024

List of 39 Members Present at the Meeting is attached as Annexure. Shri Mahesh Kapoor, the President of the IRT presided over the meeting ED/IRT read out the obituary of the IRT members who had passed away since the last AGM held on 23/12/2023. S/Shri Sandeep Bhandari, Shri Ashok Bhatnagar, Shri K. K.Gupta, Shri Ajit Chaturvedi, Shri H. J. Pavamani, Shri Satya Prakash Sharma, Shri Pankaj Malviya and Shri Krishan Lal. ED/IRT then requested all those present to stand and observe a one minute silence in their memory.

President's Address

It gives me great pleasure to speak to you today. It was a fitting tribute to pay our respects to our departed colleagues, who had contributed their might to make the Society grow in strength from year to year. I am sure all of us will have fond memories of them and others who preceded them.

The performance of the Society during the year has been good. It has been successful in conducted activities to further its objectives of creation of knowledge and its dissemination in the field of transport. I think its occupation with bringing about changes in its Rules to conform to the changing realities of its structure perhaps has come in the way of organizing more activities.

Never the less it has successfully managed the transition to a more prudent financial management of its affairs, which will have its benefits in the years to come. Maybe to increase the coverage of its future activities it can work on a model of a combination of a physical and on-line meeting. It has successfully conducted its contact classes as well as end of the year diploma examinations on-line.

The initiative for conducting Executive Development Programme, was very well received and resulted in demand for more such programmes on related topics in the near future. IRT is planning for more such programmes in the near future. I wish them all success in their endeavors.

I would also like to congratulate the medal winners of the Diploma Courses and wish them a bright future in the years to come.

In the end I would also like to convey to all of you and your family Season's greetings.

With the permission of the chair, ED/lRT readout the Secretary's report and then took up items on the Agenda for consideration.

Distribution of Medals and Cash Awards to Diploma holders.

The names of the winners of Gold, Silver and Bronze Medals of the Diploma courses offered by the Society were read out by the ED IRT and the winners, who were present, were given the medals and cash awards by the President IRT. The medal winners were:-

Diploma Course in Rail Transport & Management (RTM)

During the academic session 2023-2024 the number of fresh candidates enrolled for the Diploma Course was 74. Examination for this Course was held online in July, 2024. Out of this 53 were declared successful. The names of the candidates who secured the first three positions with marks obtained by them are as follows:-

1.	Ms. Marina Saju Thomas	1st Position	454/600
2.	Shri Naidu Naga Naresh	2nd Position	435/600
3.	Shri Alluri Venkatesh Reddy	3rd Position	433/600

Diploma Course on Transport Economics & Management (TEM)

During the academic session 2023-2024 the number of fresh candidates enrolled for the Diploma Course was 11. In addition 01 registered as "reappeared" candidates. Examination for this Course was held online in July, 2024. Out of this 18 were declared successful. The names of the candidates who secured the first three positions with marks obtained by them are as follows:-

1.	Shri Abhishek Sharma	1st Position	441/600
2.	Shri Prashant Kumar Verma	2nd Position	437/600
3.	Shri Alok Kumar	3rd Position	425/600

Diploma Course in Multi-Modal Transport (MMT)

During the academic session 2023-2024 the number of fresh candidates enrolled for the Diploma Course was 44. In addition 03registered as "reappeared" candidates. Examination for this

Course was held online in July, 2024. Out of this 29 were declared successful. The names of the candidates who secured the first three positions with marks obtained by them are as follows:-

1.	Shri Vishal Pratap Singh	1st Position	464/600
2.	Shri Prahlad Kumar	2nd Position	459/600
3.	Shri Naba Kishore Pradhan	3rd Position	456/600

The minutes of the last AGM (23.12.2023) were passed and taken as confirmed.

Secretary's Report for the Annual General Body Meeting for the Year 2024

Mr. President and Members of the Institute of Rail Transport. I have great pleasure in welcoming you to the Annual General Meeting of the Institute. The Institute has completed another year, and has entered its 61st year.

During the year, Society organized a talk on Hydrogen the fuel of the future by Shri S. K. Suri, retired General Manager and organized a panel Discussion with Diamond Jubilee Day on 4th August, 2024. During the year we conducted four Executive Development Program in January, April, August, and November, 2024.

The society well organized a seminar on Vande Bharat trains on 7th December, 2024. One meeting of the Governing Council was held, on 18th September, 2024 to consider the Annual Accounts and take decisions on important issues.

Institute of Rail Transport after a long wait of 15 years have now decided to open its enrolment for Life Membership. The criteria for opening membership, working in various sectors of rail transport, educators and researchers, experts like logistics, Infrastructure, and transportation and the students pursuing studies in rail transport engineering and related fields.

The latest position available in respect of enrolment in each of the courses as compared to the previous four years is given below:-

Years	TEM	MMT	RTM	PDM
2019-2020	29	78	121	NIL
2020-2021	29	33	66	NIL
2021-2022	22	66	91	NIL
2022-2023	24	69	84	03*
2023-2024	10	44	74	07*

ED/IRT then read out the main features of the Annual Accounts for this year, The institutes' gross income comes to Rs.84,43,391 and total expenditure works out to Rs.63.10,109 IRT is left with a pre-depreciation surplus of Rs.21,33,282 After depreciation charges of Rs. 42,237 the surplus of Rs. 20,91,045 is transferred to the General Fund.

Consideration of the Audited accounts and Budget proposals**:**

The annual Account and the Budget for the year under consideration were passed by the General Body after discussion.

Appointment of Auditors for the year 2024-2025.

In accordance with the approval by the Governing Council, Secretary/IRT proposed reappointment of M/s D. Singh & Co. as IRT auditors for the year 2024-25 at annual remuneration of Rs.50,000/- + GST. This was approved by the General Body.

The ED/IRT read out the names of the elected office bearers and members of the Governing Council for the year 2025 and 2026.

S.NO	POST	NO. OF POSTS	NAME
1	PAST PRESIDENT	1/3	SHRI MAHESH KAPOOR
2	TREASURER	1	SHRI SANJEEV SHARMA
3	MEMBERS	15/17	DR. BADRINARAYAN SHRI L. C. MONGA SHRI RANJIT SINGH VIRDI DR. N.K.TULI SHRI S.K.SURI SHRI SANJAY MISHRA PROF. (DR.) N. JENA SHRI M.G. ARORA SHRI PURUSHOTTAM GUHA DR. VENI MATHUR SHRI S.S.MATHUR SHRI ALOK KUMAR SHRI L.R.THAPAR SHRI KISHORI LAL SHRI JAGMOHAN SINGH PAHUJA

Suggestion from Members

The suggestion regarding issue of Member Identity Cards on payment basis shall be considered once the address, Mobile Number and E-mails of all members are updated in our records.

Vote of Thanks.

The meeting ended with ED/IRT proposing a Vote of Thanks to the President/IRT, two Vice Presidents/IRT, Secretary/IRT and Treasurer/IRT as well as the members attending the meeting, who contributed to the success of the AGM by their presence. He also thanked the newly elected Members of the IRT Governing Council.

OBITUARY
(As on April,2025)

Institute of Rail Transport deeply regrets the sad demise of S/Shri K.K.Gupta, Asit Chaturvedi, H.S. Pavamani, Satya Prakash Sharma, Krishan Lal, Pankaj Malviya, Ras Bihari Das, Sudershan Seth, Ranbir Kashyap and Mrs. Aarti Khosla

Institute of Rail Transport and its Members express their heartfelt condolences to the bereaved families

RNI NO. 55503/92

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