

AI Berth Sharing: Elevating Indian Railways Journeys

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I. Abstract:

*This initiative aims to alleviate overcrowding in unreserved (U/R) compartments of Indian Railways by utilizing machine learning (ML) to identify passengers willing to share their reserved berths in sleeper or 3A compartments. The objective is to enhance the travel experience for middle-class passengers by offering reduced reservation charges to those willing to share their seats. Additionally, the initiative seeks to allocate seats in the sleeper/3A compartment to passengers unable to reserve sleeper or 3A seats. By leveraging Indian Railways' data, the goal is to recommend and incentivize seat sharing, thereby facilitating improved ticket checks and fine levies by ticket collectors, ultimately contributing to increased revenue generation for Indian Railways. Simultaneously, this business model offers opportunities for the **implementing company** to leverage AI-driven operations effectively.*

II. Problem Statement

Overcrowding in Unreserved Compartments:

The unreserved (U/R) compartments within Indian Railways experience significant overcrowding, presenting challenges for ticket collectors to conduct effective ticket checks. This overcrowding not only diminishes the travel experience for passengers but also complicates the regulation and imposition of fines for unauthorized travel. Furthermore, the inability of middle-class passengers to secure sleeper or 3A reservations creates a demand-supply gap, affecting passenger comfort and hindering revenue generation potential for Indian Railways. Addressing this issue necessitates an innovative solution that harnesses technology to optimize seat utilization, enhance ticket checks, and improve revenue streams for both Indian Railways and the implementing company.

III. Market/Customer/Business need Assessment

Customer assessment

Our potential customers are individuals in India, particularly those belonging to the middle class, who are seeking a more comfortable and convenient travel experience within the constraints of their average monthly income, which typically ranges from 10,000 to 12,000 INR. Given the current living standards in India (ranked at 56 in quality of life), where cost considerations play a crucial role, train travel is a preferred and economical mode of transportation.

The crowded conditions in General/UR coaches of Indian Railways, coupled with the limited availability of these coaches, have created challenges for passengers seeking a more pleasant journey. Many individuals are willing to pay a premium for enhanced comfort and convenience, even if it exceeds the minimal cost of a general ticket. This presents an opportunity for our service to cater to those passengers who value a more relaxed travel experience and are willing to contribute to the optimization of seat utilization, thereby increasing overall revenue.

Market assessment

In the current market landscape, there are several authorized partners of IRCTC, such as Paytm, Ixigo, Moovit, Trainline, and RailYatri. These partners have successfully provided a seamless experience for train bookings, including tatkal ticket reservations. Additionally, IRCTC has expanded its services through authorized partners like Zomato, enhancing food choices for railway passengers.

While Paytm leads with a 14% market share in IRCTC ticket booking, the proposed business idea remains unexplored by existing authorized partners. This presents a unique opportunity for any new player entering the market with a ticket booking option integrated with the innovative concept. Given the apparent gap in the market, there is potential to capture a significant share, tapping into the unmet needs of passengers seeking improved comfort and convenience during train travel. The absence of similar services from existing partners indicates a potential market demand for the proposed solution.

IV. Detailed Business understanding

Data understanding and calculations

To gain a thorough understanding of our business model, let's narrow our focus to the "Seemanchal Express" train and conduct a comprehensive analysis of ticket prices across all coach classes, spanning from General/Unreserved to 1st AC Tier

From Station: *Tundla Junction*

Till Station: *Ghaziabad Junction*

Note- Please Note: The figures provided below are **approximations, and the actual values may vary. Therefore, it is advisable to maintain flexibility in consideration of these numbers.*

Coach	Total berths/coach	Person/berth	Total Passengers/coach	Ticket Price/passenger	Revenue in digits	Revenue in (%)
General/UR	95	4	380	90	34200	23.07
Sleeper	75	1	75	175	13125	8.85
3A	68	1	68	555	37740	25.45
2A	50	1	50	760	38000	25.63
1A	21	1	21	1200	25200	17
Total	309	8	594	2780	148265	100

**Data and calculation-*

- *Person/berth refers Person usually sit on one berth in general coaches (This number may vary with the actual figure)*
- *Total berths/coach refers Total number of berths in a coach, here we have taken the **average** of the number of berths in ICF (Integral Coach factory) and total number of berths in LHB (Linke Hofmann Busch)*
- *Total Passengers = Total berths * Person per berth in a coach*
- *Ticket price is taken from station **Tundla junction** to **Ghaziabad junction** (for calculation purpose)*
- *Revenue = ticket price * total passengers travelling*

Real problem does not follow this math – It is even worse than that

Actual Scenario Vs Hypothetical Scenario



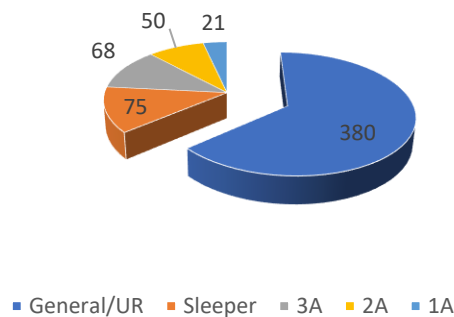
***This picture is generated by an AI application*

Inferences-

- *Left picture is the actual condition of General/UR coaches (It can even worse in reality)*
- *Right picture is the hypothetical situation that we desire*

Visualizations:

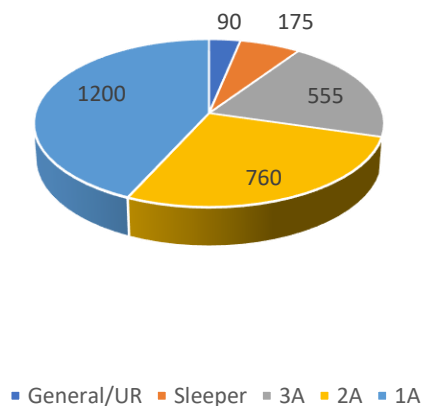
Passengers distribution in coaches



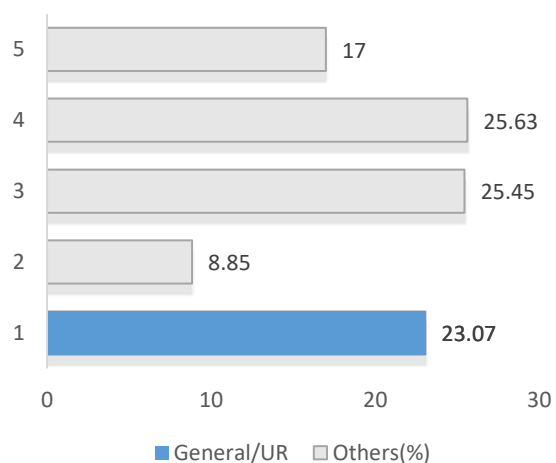
Inferences and assumptions –

- Kindly be aware that the numbers presented below are **approximate**, and the actual values might differ. Thus, it is recommended to remain flexible when interpreting these figures
- To gain a thorough understanding of our business model, let's narrow our focus to the "Seemanchal Express" train and conduct a comprehensive analysis of ticket prices across all coach classes, spanning from General/Unreserved to 1st AC Tier

Ticket Price(INR)



Indian Railways Revenue(%)



*Inferences-

- Approx **23%** of the revenue is **supposed** to be from General/UR coaches
- Due to the absence of ticket checking, Indian railways incurs losses every year.
- Ticket price chart of Unreserved coaches and Sleeper or 3A coaches can be seen as a hope of generating more revenue by relocating the passengers from UR to above class coaches

V. Target Specifications and Characterization

In our focus, the primary target demographic comprises individuals from the middle-class who, due to unforeseen circumstances, are unable to secure reservations in sleeper or 3A class at the last minute. Consequently, they find themselves compelled to travel in the general coach, where obtaining a seat is subject to luck. Recognizing the value of comfort, these middle-class individuals are willing to pay a slightly higher amount (within reasonable limits) to secure a more comfortable seat in the sleeper or 3A class, shared voluntarily by another passenger in that coach.

VI. Benchmarking alternate products

Considering the current market landscape, no existing company offers a concept similar to ours. However, it is noteworthy that Indian Railways has a concept known as RAC (Reservation against Cancellation). In the RAC system, passengers with RAC tickets share a berth with another RAC ticket holder. Two scenarios could lead to the availability of an empty seat:

- 1) Last-minute cancellations for confirmed seats and
- 2) Unsold quotas.

It's important to distinguish our model, which focuses on voluntary seat sharing for enhanced comfort, from the existing RAC system.

There are some differences in our berth sharing concept and RAC provided by IRs

S.No.	Enhanced seat sharing	Reservation against cancellation (RAC)
1	Willingness for sharing the berth of both the passengers	No such willingness in both passengers
2	Passengers have choice whom he/she wants to share the berth with	No such choices available in RAC, sometime it becomes the concern for a women safety.
3	Reduction in the ticket price who is willing to share the berth	No clear refund policy by IRCTC, Passenger has to file TDR up to 72 hours of the actual arrival of the train
4	Embracing customer willingness	Generally, Passenger shows negative feedback

VII. Applicable Patents

For the proposed AI-driven berth sharing business model, several potential areas for patent consideration include:

- User Interface and Experience Design: If the user interface (UI) and overall experience design are distinctive and contribute significantly to the model's success, patenting elements of the UI or the design process may be considered.
- Dynamic Pricing Models: If the business model involves innovative dynamic pricing strategies for ticket fares or berth sharing commissions, these strategies may be eligible for patent protection.

- **Integration with Railway Systems:** Patents could be explored for the integration process and techniques that facilitate seamless communication and collaboration with existing railway systems, ensuring compatibility and efficiency.

VIII. Applicable Regulations

Indian Railways Regulations: Ticketing Regulations: Indian Railways has specific guidelines for ticketing, including rules related to reservations, cancellations, and fare policies. Any system implementing additional payments for seat sharing would need to align with these regulations.

Passenger Safety and Comfort: Ensuring the safety and comfort of passengers is a priority for Indian Railways. Any service or system introduced to facilitate seat sharing should not compromise safety standards or infringe upon passengers' rights.

Transaction and Payment Regulations: Handling financial transactions within a railway context might need to adhere to certain banking and financial regulations, including security measures for online transactions.

Data Privacy and Security: Gathering passenger data for the purpose of predicting willingness to share seats must comply with data protection laws in India, ensuring the privacy and security of passenger information.

Compliance and Adherence:

Before implementing your service, it's crucial to conduct a comprehensive legal and regulatory analysis. This might involve consulting legal experts familiar with transportation regulations, data privacy laws, and financial regulations in India. Ensuring compliance with all relevant laws and regulations is essential to avoid legal issues and to gain the trust of both passengers and regulatory bodies.

IX. Applicable Constraints

- **Night Travel Hindrance (Primary Hurdle):** The likelihood of berth sharing diminishes significantly as all travel occurs during nighttime. Passengers may be reluctant to share their berths in these conditions.
- **Consistent Data Management Requirement:** Due to the integration of machine learning, our model relies on consistent and efficient data management. Continuous updates and maintenance are essential for optimal functionality.
- **Extended Implementation Timeline:** Achieving full implementation is projected to span the next 3-4 years. Given the novelty of this business model, the absence of precedence necessitates the collection of new data features, such as the 'willingness of passengers to share berths,' for an enhanced recommendation model.
- **Complete Reliance on Willing Middle-Class Customers:** The success of our model is contingent upon the willingness of middle-class customers to pay a slightly higher fare for a more comfortable journey. If this willingness is lacking, it directly impacts the company's revenue.

X. Business Model

In our business model, the financial transactions involve three key entities:

- Indian Railways
- Passengers Utilizing the Service
- Service Provider (Our Company)

Our company will charge a **commission** solely for the services provided, forming the basis of the financial transactions within this model.

XI. Financial Viability for Indian Railways

TRAVEL / THINGS TO DO / Indian Railways to increase train fares this week to battle revenue loss

Indian Railways to increase train fares this week to battle revenue loss

Times Travel Editor / TRAVEL NEWS, INDIA / Created : Dec 25, 2019, 00:01 IST

Indian Railways' revenue remains off track for 2nd straight financial year

The revenue generated by the Indian Railways remains weak for the second consecutive year due to lower passenger ticket sales and higher expenditure towards maintaining Covid-19 safety guidelines.

With operating ratio of 107.39 per cent, Railways could not generate surplus in 2021-22: CAG

Updated: Aug 08, 2023, 08:58:00 PM IST

FOLLOW US SHARE FONT SIZE SAVE PRINT COMMENT 3

Synopsis

The CAG said that the entire profit of Rs 36,196 crore from freight traffic was utilized to cross subsidize/compensate the loss on operation of passenger and other coaching services. The loss of Rs 32,073 crore from passenger operations was left uncovered during 2021-22.

Whether in the challenging times of 2019 during the COVID-19 pandemic or the subsequent growth period of 2023, Indian Railways has consistently faced **revenue challenges**. In the last few years, the financial strain on the railways has been substantial. The proposed AI-driven berth sharing business model emerges as a strategic solution to mitigate this revenue problem in two impactful ways.

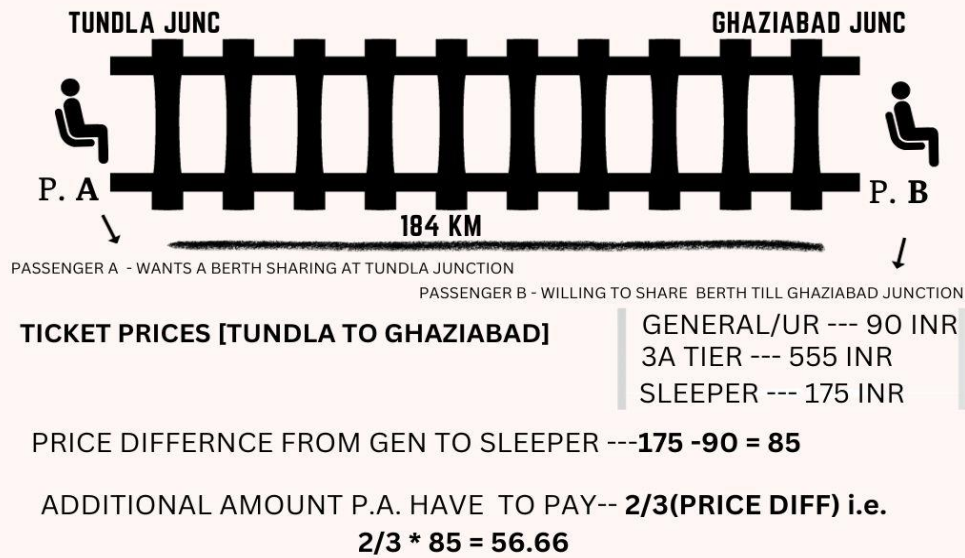
Firstly, by addressing the chronic overcrowding issues in general/UR coaches, the model streamlines ticket checks for collectors, potentially resulting in more fines collected. This not only improves operational efficiency but also enhances revenue generation.

Secondly, a noteworthy aspect of the proposed model is that 20% of the relocation cost directly contributes to Indian Railways' revenue. This dual-pronged approach not only tackles the immediate revenue concerns but also positions the business model as a proactive and beneficial contributor to the financial well-being of Indian Railways. By offering practical solutions to revenue challenges, the proposed model stands as a testament to the adaptability and innovation necessary for the sustained success of Indian Railways, irrespective of the economic landscape.

XII. Concept Development

Fare/Price Determination for Birth Sharing

BIRTH SHARING PRICE CALCULATION



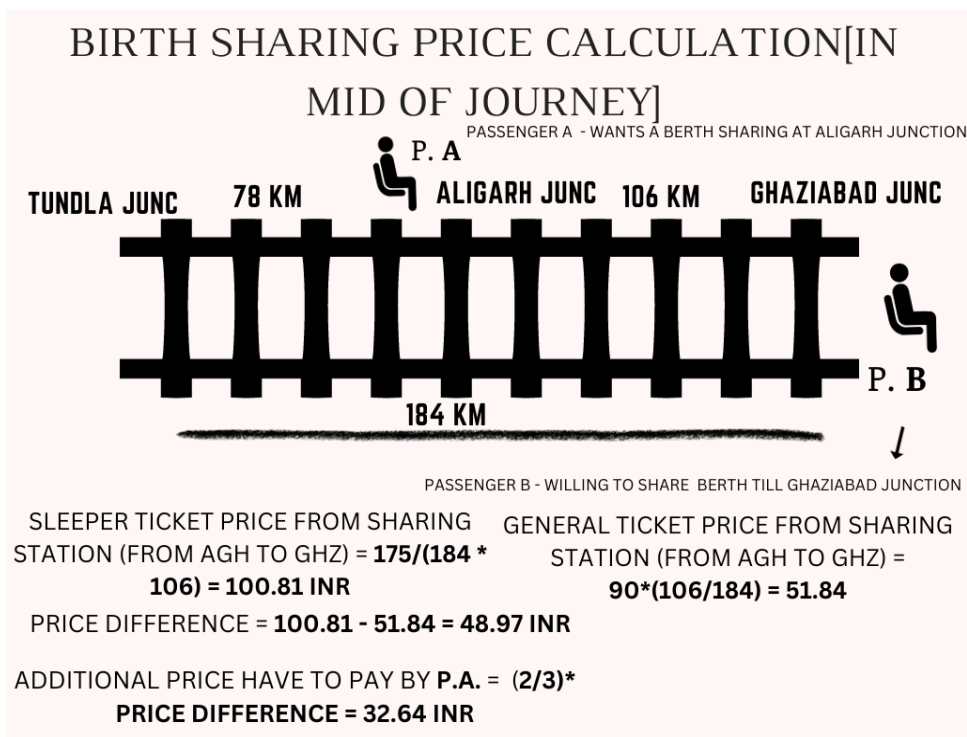
ONBOARDING RAILWAY STATION TUNDLA JUNCTION		OFFBOARDING RAILWAY STATION GHAZIABAD JUNCTION
SERVICE PROVIDER SHARE	PASSENGER B SHARE	INDIAN RAILWAYS SHARE
20%	60%	20%
COMMISSION OF SERVICE PROVIDER	PASSENGER B 's SHARE	INDIAN RAILWAYS ' SHARE
20/100 * (ADDITIONAL AMOUNT PAID BY P. A)	60/100 * (ADDITIONAL AMOUNT PAID BY P. A)	20/100 * (ADDITIONAL AMOUNT PAID BY P. A)
11.33 INR	33.99 INR	11.33 INR
NET AMOUNT PER OPERATION = +11.33 INR	NET AMOUNT PER OPERATION = 175 - 33.99 = ~142	NET AMOUNT PER OPERATION = +11.33 INR

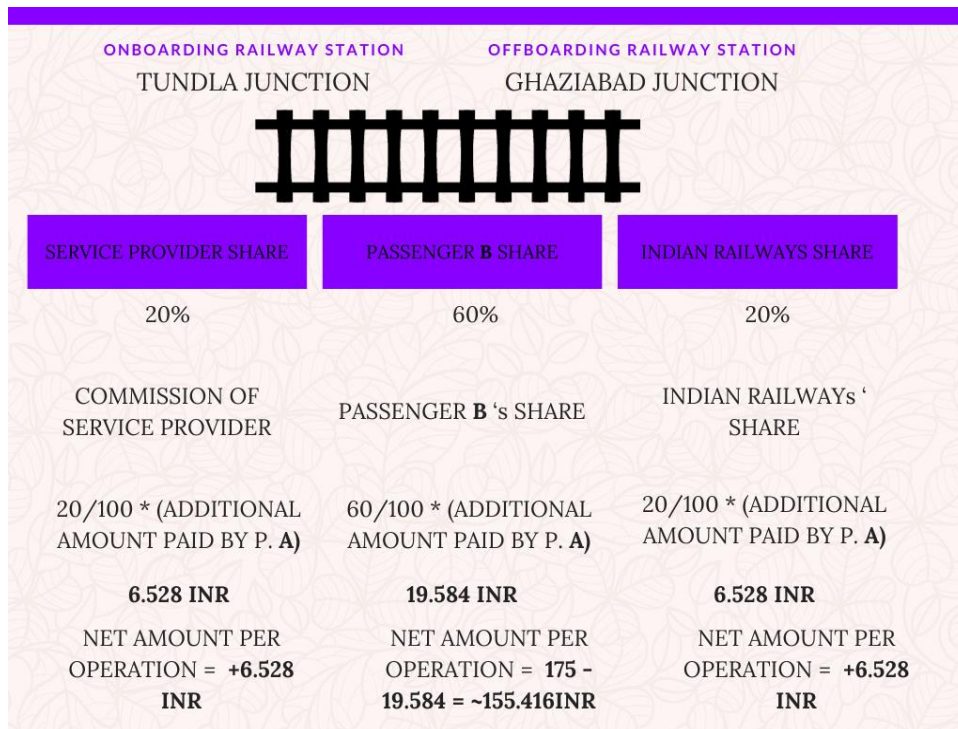
**Distribution of cost per successful operation*

Entities	PAID (-)[INR]	RECEIVE (+)[INR]	NET [INR]
Passenger A	(-90) + (-56.66)	0	-146.66
Passenger B	-175	+33.99	~-141.01
Service Provider	0	+11.33	+11.33

Indian Railways	0	+11.33	+11.33
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Upon examining the calculations provided above, it is essential to consider scenarios where Passenger A seeks berth sharing not from the origin of their journey but from an **intermediate station**. In such cases, the calculation will be as follows –





Entities	PAID (-)[INR]	RECEIVE (+)[INR]	NET [INR]
Passenger A	$(-90) + (-32.64)$	0	-122.64
Passenger B	-175	+19.584	-155.416
Service Provider	0	+6.528	+6.528
Indian Railways	0	+6.528	+6.528

Concept Development: AI Implementation

In our business model, the most effort taking part is to find the passenger who is willing to share his/her berth with other passenger. This is where we are going to use machine learning skills.

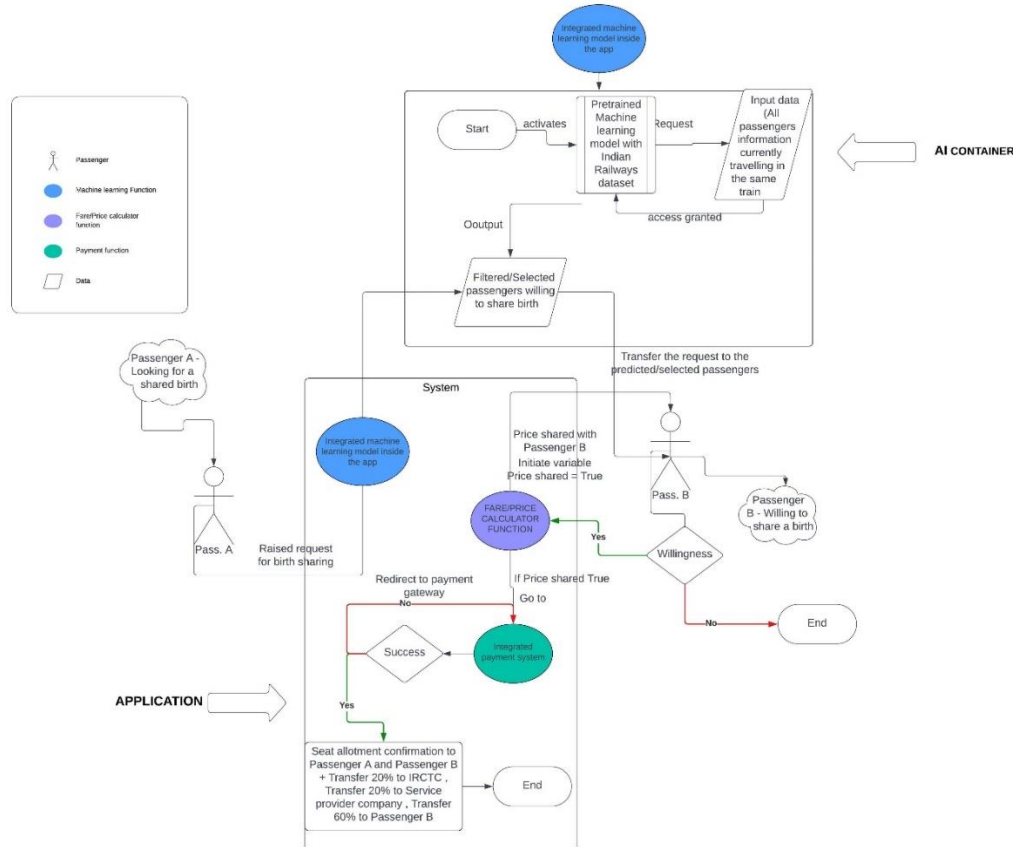
For this we are required to have a huge dataset and should be having necessary features like distance travelled, journey started at station, journey ended at station, day travelling, night travelling and main output feature '*birth sharing willingness*'

XIII. Concept Generation (Personal Motivation and Background)

Growing up in a middle-class family, I personally encountered the challenges associated with last-minute travel. The inability to secure a reservation often forced me into the overcrowded general coaches, where obtaining a seat was a struggle, contingent on the route. Faced with

such situations, I even resorted to paying bribes to Ticket Checkers in the hope of securing an unreserved left berth in reserved coaches. These experiences ignited a determination to devise a solution, inspiring the concept presented in this report.

XIV. Product Prototype



XV. Code implementation demonstration

The GitHub link provided showcases the practical implementation of artificial intelligence within this business model. I invite you to review the demonstration to gain a deeper understanding of how AI is integrated and applied to enhance the functionalities and outcomes of the business. Your insights and feedback are valuable in further refining and optimizing the AI implementation for better results.

https://github.com/codedestructed007/EDA_on_Indian_Railways/blob/main/EDA_Indian_railways.ipynb

XVI. Conclusion

In conclusion, the AI-driven berth sharing business model, inspired by personal experiences and tailored to alleviate the challenges of last-minute travel in Indian railways, aims to optimize seat utilization and elevate the overall passenger experience. Acknowledging inherent constraints, the model's potential benefits underscore the transformative impact of technology on railway travel, fostering a win-win situation for IRCTC, passengers, and the

railway system at large. The journey ahead involves strategic planning, adaptability, and a commitment to leveraging technology for the collective well-being of all stakeholders in the railway ecosystem.

XVII. References

<https://timesofindia.indiatimes.com/travel/things-to-do/indian-railways-to-increase-train-fares-this-week-to-battle-revenue-loss/articleshow/72960108.cms>

<https://www.indiatoday.in/business/story/indian-railways-revenue-remains-off-track-for-2nd-straight-financial-year-1883002-2021-12-01>

https://indianrailways.gov.in/railwayboard/view_section.jsp?lang=0&id=0,1,304,366,523,2530

<https://www.forbes.com/advisor/in/business/average-salary-by-age/#:~:text=Average%20Salary%20by%20State%20in%20India,-The%20more%20the&text=According%20to%20the%20above%20table,about%20INR%2021%2C000%20per%20month.>