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Web based Resource Management System for Monitoring of Pre-Departure Detention (PDD) & Critical Information Related to Loco Pilots/Astt. Loco Pilots– Key to Increased Availability & Utilization of Loco Pilots/Astt. Loco Pilots in Indian Railways.

Sanjay Priyadarshnam, PhD Scholar, Prof. Neeraj Sharma
School of Computer Science & Application, School of Computer Science & and Application,
IIMT University, Meerut, India, IIMT University, Meerut, India,
priyadarshnamsanjay@gmail.com,
talk2neerajsharma@yahoo.co.in,

Abstract

The management of train crews in the railway industry is a complex task that involves numerous challenges comprising of recruitment, training and Skill Development, Compliance with Regulations, Crew Scheduling Complexity, Dynamic Operational Environment, Crew Availability and Fatigue Management, Communication Challenges, Crew Satisfaction and Retention and Interoperability with Other Systems among other things.

With the continuous increase in the number of trains and corresponding increase in number of train crews, the data related to train operation in respect of crew management is huge and very difficult to manage manually. The present manual management of data is often leading to inefficient working resulting is wastage of precious manpower having huge financial implications.

Timely availability of accurate data is necessary to minimize wastage of crew leading to lesser detention of specially freight trains on account of crew.

Furthermore, with the integration of modern day technologies will enable Crew managers to adopt a data-driven approach to decision-making, facilitating more informed and efficient management of crew for overall satisfactory utilization.

In conclusion, the proposed web-based IT system as a tool for the management of Crew will bring efficiency, data-driven decision-making, and proactive strategies to the Railway Industry. By harnessing the power of technology and real-time data, there will be holistic utilization of crew resulting in operation of more numbers of freight trains leading to increase in revenue and performance of the entire railway network.

Keywords – Crew, PDD

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I. Introduction

At 31 March 2022, the Indian Railways (IR) oversaw the world's fourth-longest national railway system, with a total of 68,155 km of routes, 102,831 km of running track, and 128,305 km of track.

On an average, Indian Railways carries 810 crore passengers and transports 1420 million tonnes of freight by running approximately 13,169 passenger trains & 8,479 freight trains on daily basis.

To manage the operations of the world's largest network (under a single management), Indian Railways has more than 100,000 Loco Pilots (Drivers) and Astt. Loco Pilots (Astt. Drivers) which forms the basic functioning team, responsible for Train Operations.

For running such a vast fleet of trains, the train crew plays a critical role in the safe and efficient operation of trains. The crew members are responsible for various tasks that contribute to the overall functioning of the railway system. The roles of train crew members are crucial in maintaining the reliability, safety, and efficiency of railway operations. Their responsibilities encompass various aspects of driving, safety, communication, and customer service to ensure a seamless and secure travel experience for passengers.

The utilization of train running staff in the context of railways generally refers to effectively deploying and managing the workforce involved in the operation and maintenance of trains. Train running staff includes various personnel such as locomotive pilots (drivers), co-drivers, guards, and other crew members responsible for the safe and efficient movement of trains.

Unfortunately, trains are forced to wait at the outer signal or the nearby station until other trains leave the platform, which is a waste of train crew time because the platform or line is not available.

If trains are unable to stop at the stations, if there are insufficient stabling or pit lines, if there is no clear access beyond the platforms, or if trains are late departing from the platforms for reasons such a lack of personnel or locos, the platform may get filled.

After careful monitoring, the Lobby takes remedial actions regarding the pre-departure detention to the Crew, the rescheduling of Locos, and the yard detentions to Locos.

Making decisions quickly may increase safety, maximise resource utilisation, minimise freight train delay due to a lack of personnel, and maximise the use of train crews.

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II. Difficulties in the traditional approach of record-keeping

The voluminous data generated during train operation which mainly in respect of booking of crew, rescheduling of crew, crew balancing, spare movement of crew, training of crew etc. are recorded in manual registers. These records are required to be analyzed in decision making process during train operation which guides the crew manager to take a balanced decision.

With the increase in number of trains and train crew, it is nearly humanly impossible to efficiently manage related information for taking management decision.

Similarly, training of train crews unlike other staff is altogether a different task. A train crew is expected to go through a large number of refresher, safety courses, medical tests, simulator training & promotional courses which are conducted not only at different specialized places but often at very far places away from their place of work. Nomination of training for such staff is a very specialized work as training has to be managed in such a way that enough manpower is available to work the planned train while ensuring that none of the train crew is available for train working who is due for any such mandatory training because it is mandatorily prohibited to employ such train crew to work any train.

At present all such works are being managed manually resulting into inefficient working. Therefore, there is a need for a web-based application to facilitate record-keeping of booking of train crew and recording instances of pre-departure detention of train crew at each crew changing point. Besides this, the proposed IT system should have provision to record details of all training completed by each employee and the system should be able to generate MIS report for arising of training as on any date selected by Crew Manager.

III. Introducing the proposed Web based Resource Management System

To address the above-mentioned difficulties in traditional method of record-keeping and enhance decision-making process, the concept of a web-based Resource Management System has been designed. The proposed web-based tool helps in integrating various aspects of recording all related data to keep track of Crew booking, its utilization, details of all training particulars in respect of Loco Pilots/Astt. Loco Pilots.

It provides detailed analysis of crew detained for want of path at each crew changing station so that crew booking managers have an idea of wastage of crew and also helps to take such decision to efficiently manage crew management as a whole. The data related to training particular of all employees and especially training arising as on any future date is a great help for planning training of employees besides ensuring smooth train operations.

The proposed web-based management system serves as a valuable tool for organizations to efficiently manage and track their resources, whether they are personnel, equipment, or other assets for all stakeholders, including crew managers and training manager to collaborate,

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access critical information, and make data-driven decisions. By optimizing resource allocation and facilitating efficient communication, the proposed system will empower Indian Railways to enhance the reliability, safety, and overall performance of its manpower and safe train operations, thus maintaining its status as a vital pillar of India's transportation infrastructure.

IV. System Architecture of proposed Resource Management System

The proposed web-based management system is proposed to be developed by using any modern web technologies depending upon budget, volume of data likely to be handled & several other critical considerations to ensure the system meets its objectives, is user-friendly, and performs well.

Web Technologies proposed to be used:

(i) Server side: PHP 8.1

(ii) Database: MySQL 7.2

(iii) Other technologies: HTML, CSS, Bootstrap, JavaScript, Ajax etc.

The application is intended to be built using PHP 8.1, MySQL 7.2 and other related web technologies. PHP (Hypertext Preprocessor) is a popular server-side scripting language that is widely used for web development. It has several advantages as enumerated below that contribute to its popularity in building dynamic and interactive web applications [1]:

1. **Open Source**: PHP's open-source nature and zero-cost licencing make it a great fit for startups and developers on a budget. The fact that it is open-source also implies that programmers can alter it to their liking since they have access to the code. Because of this, firms and developers may save money.

2. **Platform Independence**: PHP is compatible with a wide range of platforms, allowing it to operate on Windows, Linux, macOS, and more. Deployment flexibility is enhanced by this.

3. **Ease of Learning**: For those new to computer programming, PHP's syntax is straightforward and easy to grasp. Developers will find the learning curve to be less steep because of its similarities to C and other programming languages.

4. **Scalability**: PHP is capable of managing massive volumes of data and traffic due to its scalability. Building sophisticated web applications that can expand with the company is

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made easy with its easy integration with other technologies and platforms and its design to work well with databases.

5. **Extensive Library Support**: Applications written in PHP may take advantage of PHP's extensive library of extensions and modules to enhance their functionality and add new features. A few examples of the many subjects covered by these libraries include encryption, file management, and database connectivity. Developers are able to more easily create bespoke apps that address unique business needs thanks to the rich library support.

6. **Rapid Development**: Quick application development is a strong strength of PHP. Thanks to the availability of frameworks and its relative simplicity, developers can whip up web apps in no time.

7. **Integration Capabilities**: Connecting to data storage systems is a breeze with PHP because of its ability to work with several databases.

8. **Wide Hosting Support**: using PHP being supported by the majority of web hosts, finding hosting options for apps built using PHP is a breeze. The simplicity of deployment is helped by this extensive support.

9. **Support for Content Management Systems** (**CMS**): Many well-known content management system (CMS) systems, including WordPress, Joomla, and Drupal, are built on PHP. Website content management and updating is now easy for non-developers with these CMS choices.

10. **Security Features**: When developers utilise PHP's built-in security capabilities effectively, it may assist in creating applications that are safe. PHP protects itself against SQL injection and cross-site scripting (XSS) attacks, among other robust security measures. It comes with a bunch of security extensions and libraries that you may use to make PHP apps even more secure. Because of this, PHP applications are safer and less vulnerable to security breaches.

11. **Flexibility**: PHP's flexibility makes it a good choice for a wide range of web development tasks, such as scripting on the server side, scripting on the command line, and creating desktop apps.

12. **Performance**: The speed and efficiency of PHP are well-known. Because of how fast it can construct and optimise web apps, it's great for creating high-performance, enterprise-

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level online apps. Application speed is further enhanced by PHP's ability to process several requests concurrently.

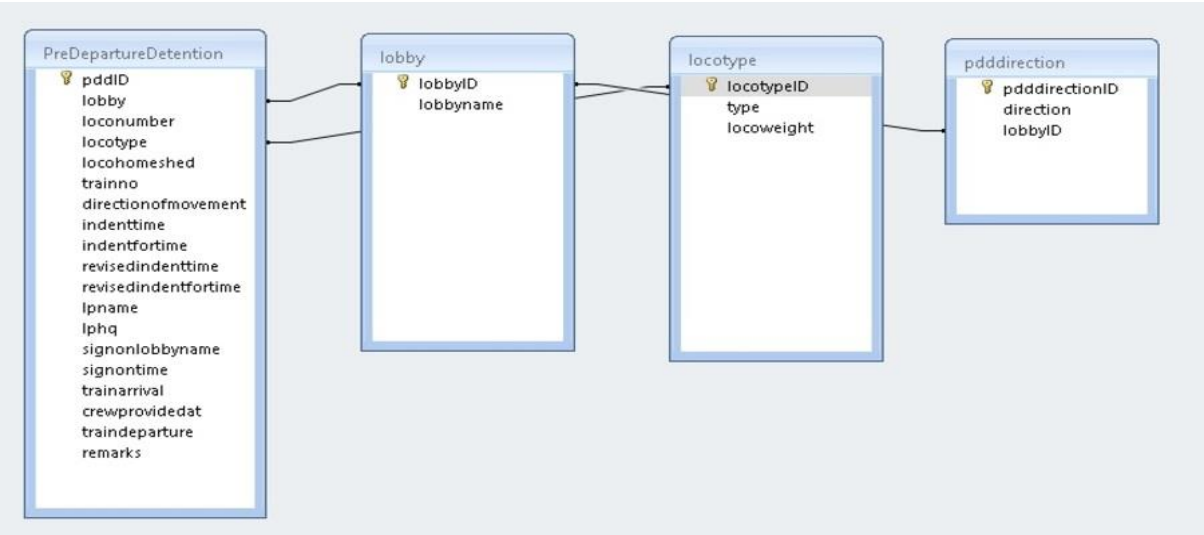
13. Large and Active Community: PHP benefits from a sizable and dynamic group of programmers who work together to improve and maintain the language. To facilitate the development of PHP applications, this community offers a plethora of resources, such as documentation, tutorials, and libraries.

14. Compatibility: Web servers such as Apache, Nginx, and Microsoft IIS are all compatible with PHP. Due to this interoperability, PHP applications may be easily deployed in a variety of hosting systems.

Even if PHP offers numerous benefits, the project's needs should be considered while deciding on a programming language. Developers may pick PHP over another language depending on project scope, team knowledge, and long-term objectives, among other considerations.

V. Process Flow of proposed system through Graphical User Interface:

A typical Database table relationship Diagram of proposed web-based Management System is illustrated below.



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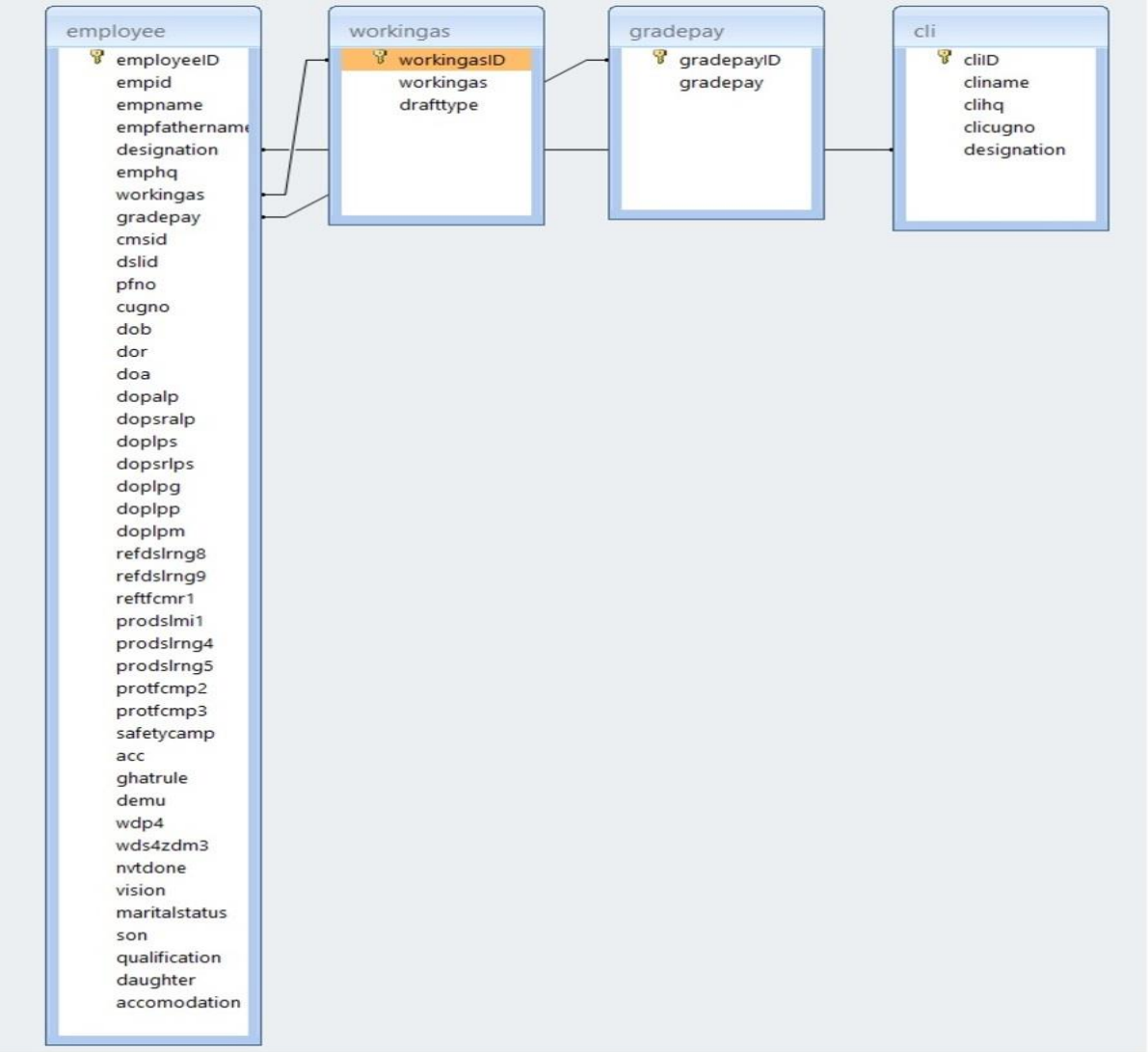

The application shall have following facilities:

a) User Management System with requisite security management.
b) Table having details of each employee including training particulars.
c) Tables having details of train for which crew is booked &details of detention duration.
d) Various MIS Reports illustrated such as:
a. Cadre position of all the employee station-wise.
b. Grading reports of all Crew.
c. Details of Crew assigned to respective Chief Loco Inspectors.
d. Details of train-wise, lobby wise Pre-Departure detention.
e. Details of training overdue as on date selected by user etc.
f. Provision of customized reports as per fresh requirements.

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VI. Benefits of the proposed System

The intended benefits expected from the proposed system has been envisaged as below:

a) The user shall have exact idea of Pre-Departure Detention of Train at all Major Train Interchange Points.

b) This will enable Train Controller to take suitable management decision to avoid wastage of Crew.

c) The management shall have details of all details Train crew including details of all training particulars.

d) The proposed system shall enable management to know the details of Train Crew due for training in various

particular mandatory or refresher course which will enable better planning of training without affecting regular train operations.

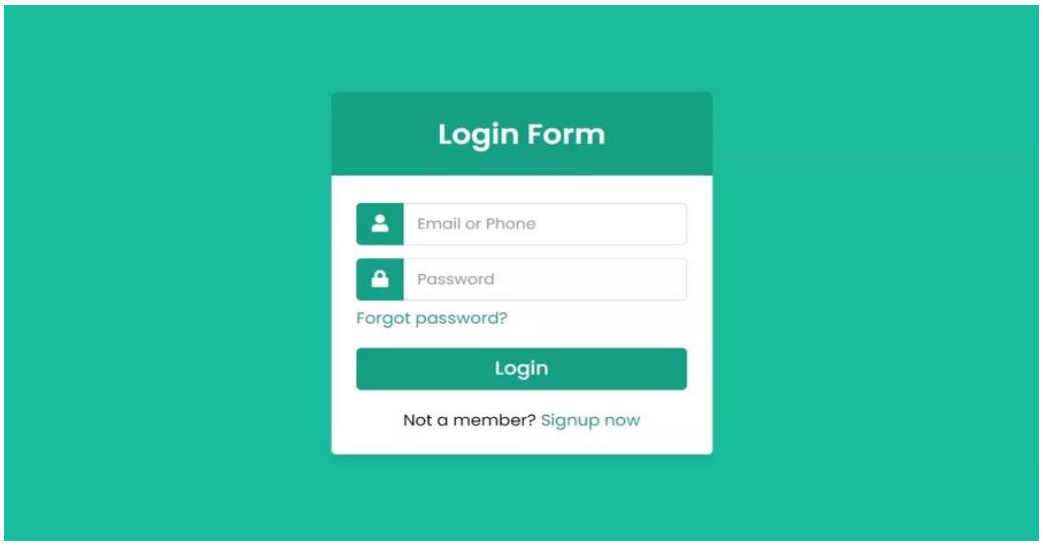
e) The proposed system will help in regulating booking of only those crew who have done all the training leading to safe & smooth running of trains.

f) The user shall be able to take data-driven decision-making leading to faster turnaround of assets.

VII. Graphical User Interface:

Some of the typical web forms proposed for the proposed Web based Resource Management System resource is appended below:

A. User Login:



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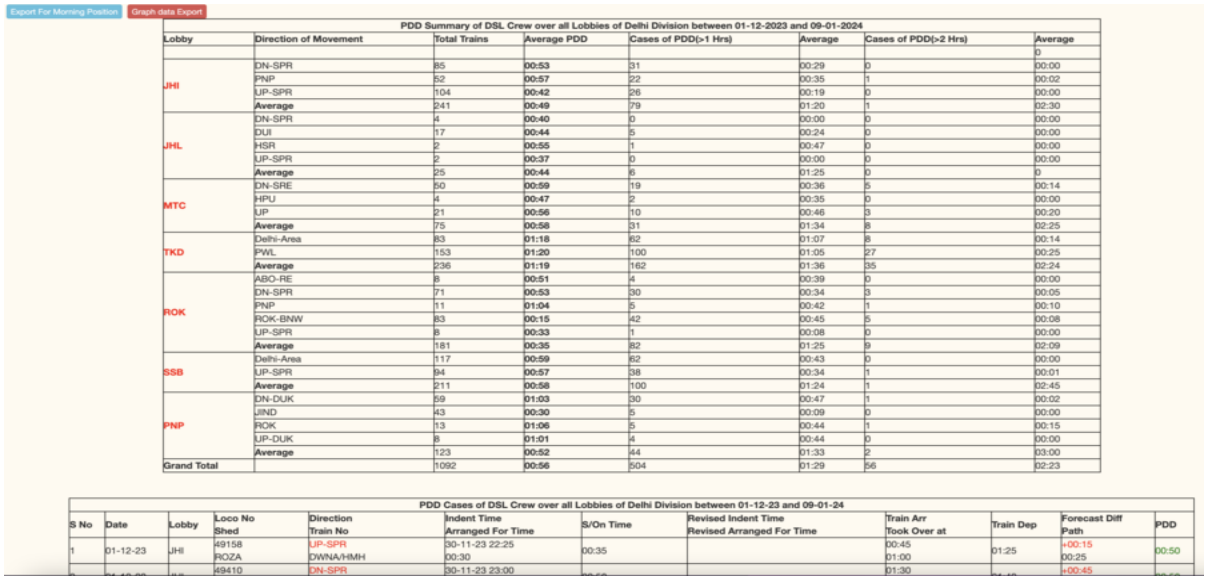
~~B.~~ Pre-Departure Date Entry:

This web form provides to record data in respect of detention of train service for any reason other than unavailability of Train Crew.

C. Pre-Departure MIS Report:

This MIS report provides information regarding details of train detained at each train interchange point with details of total trains detained and average PDD duration. This information can be viewed in various dimensions such as section-wise & Lobby wise etc. This report helps management to take important decisions related to train operations.


Export For Morning Position | Graph data Export

PDD Summary of DSL Crew over all Lobbies of Delhi Division between 01-12-2023 and 09-01-2024

Lobby	Direction of Movement	Total Trains	Average PDD	Cases of PDD(>1 Hrs)	Average	Cases of PDD(>2 Hrs)	Average
							0
JHI	DN-SPR	85	00:53	31	00:29	0	00:00
	PNP	52	00:57	22	00:35	1	00:02
	UP-SPR	104	00:42	26	00:19	0	00:00
	Average	241	00:49	79	01:20	1	02:30
JHL	DN-SPR	4	00:40	0	00:00	0	00:00
	DUI	17	00:44	5	00:24	0	00:00
	HSR	2	00:55	1	00:47	0	00:00
	UP-SPR	2	00:37	0	00:00	0	00:00
	Average	25	00:44	6	01:25	0	0
MTC	DN-SRE	50	00:59	19	00:36	5	00:14
	HPU	4	00:47	2	00:35	0	00:00
	UP	21	00:56	10	00:46	3	00:20
	Average	75	00:58	31	01:34	8	02:25
TKD	Delhi-Area	83	01:18	62	01:07	8	00:14
	PWL	153	01:20	100	01:05	27	00:25
	Average	236	01:19	162	01:36	35	02:24
ROK	ABO-RE	8	00:51	4	00:39	0	00:00
	DN-SPR	71	00:53	30	00:34	3	00:05
	PNP	11	01:04	5	00:42	1	00:10
	ROK-BNW	83	00:15	42	00:45	5	00:08
	UP-SPR	8	00:33	1	00:08	0	00:00
	Average	181	00:35	82	01:25	9	02:09
SSB	Delhi-Area	117	00:59	62	00:43	0	00:00
	UP-SPR	94	00:57	38	00:34	1	00:01
	Average	211	00:58	100	01:24	1	02:45
PNP	DN-DUK	59	01:03	30	00:47	1	00:02
	JIND	43	00:30	5	00:09	0	00:00
	ROK	13	01:06	5	00:44	1	00:15
	UP-DUK	8	01:01	4	00:44	0	00:00
	Average	123	00:52	44	01:33	2	03:00
Grand Total		1092	00:56	504	01:29	56	02:23

PDD Cases of DSL Crew over all Lobbies of Delhi Division between 01-12-23 and 09-01-24

S No	Date	Lobby	Loco No Shed	Direction Train No	Indent Time Arranged For Time	S/On Time	Revised Indent Time Revised Arranged For Time	Train Arr Took Over at	Train Dep	Forecast Diff Path	PDD
1	01-12-23	JHI	49158 ROZA	UP-SPR DWNA/HMH	30-11-23 22:25 00:30	00:35		00:45 01:00	01:25	+00:15 00:25	00:50
			49410	DN-SPR	30-11-23 23:00			01:30		+00:45	

D. Employee Management System: This MIS report provides real-time entry & retrieval of all information related to any train crew. These data are further utilized in taking many critical decisions related to booking of train crew in various types of train services.

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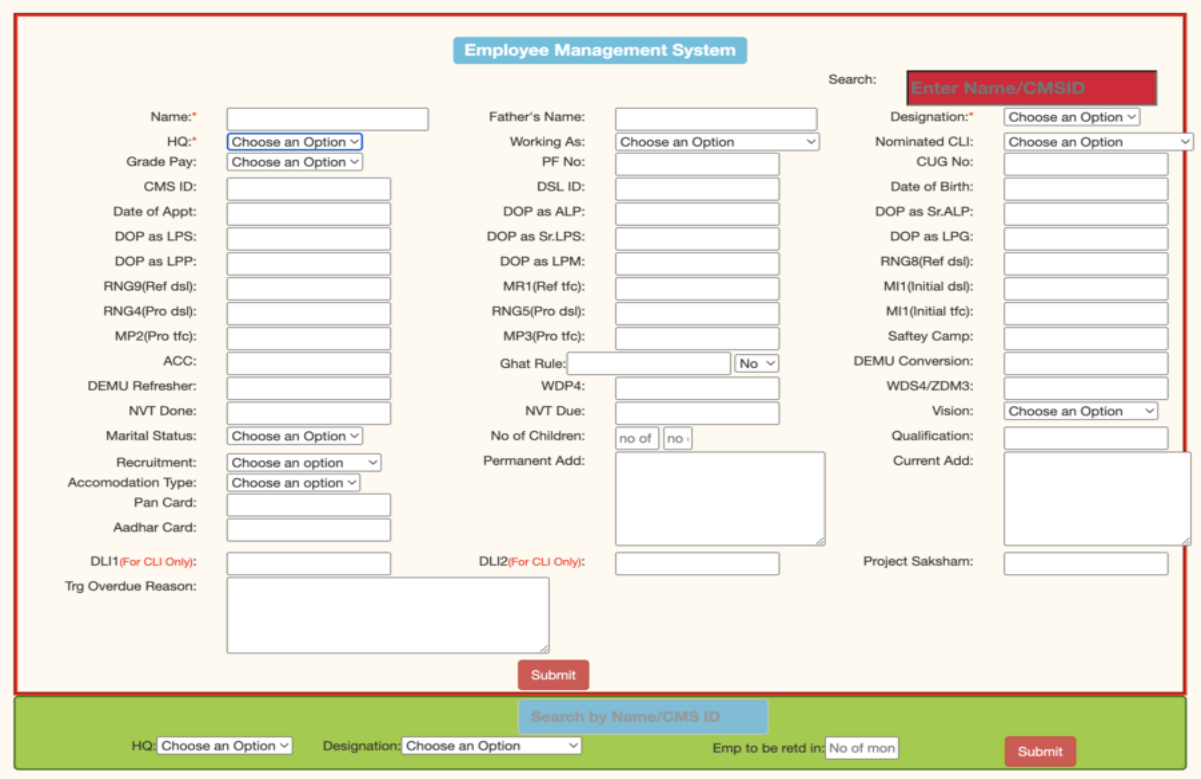
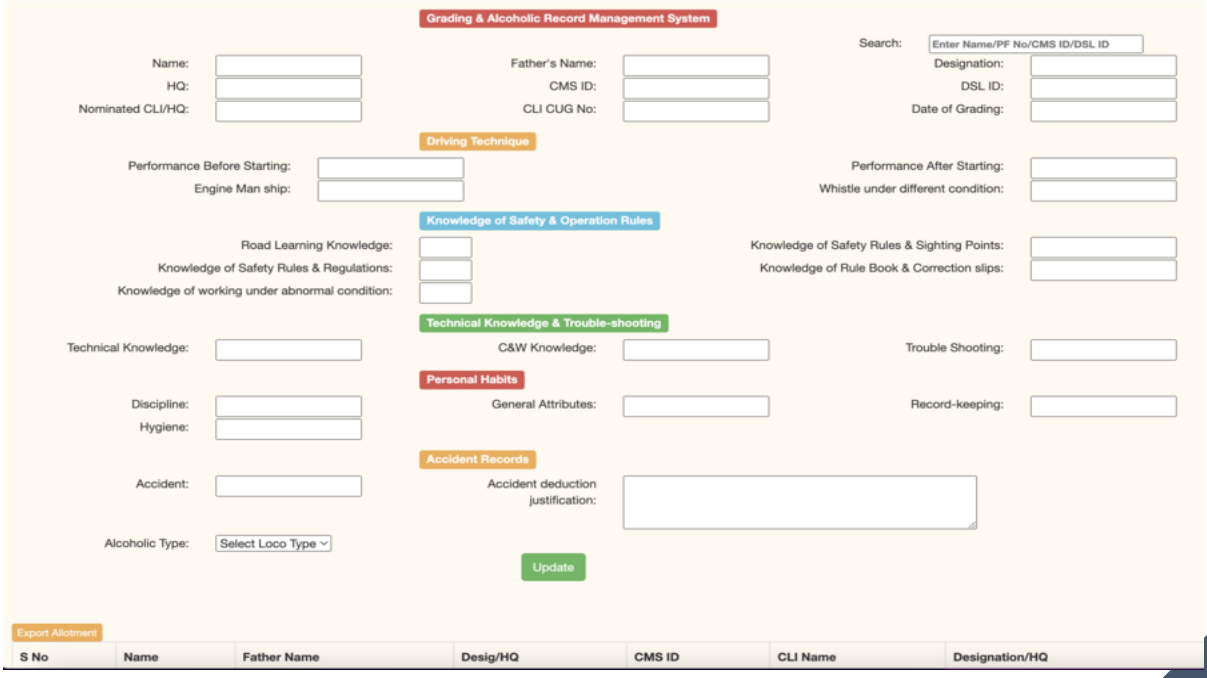


E.**Train Crew Grading Management System:** This MIS report provides real-time coach holding of a maintenance depot indicating the current status.



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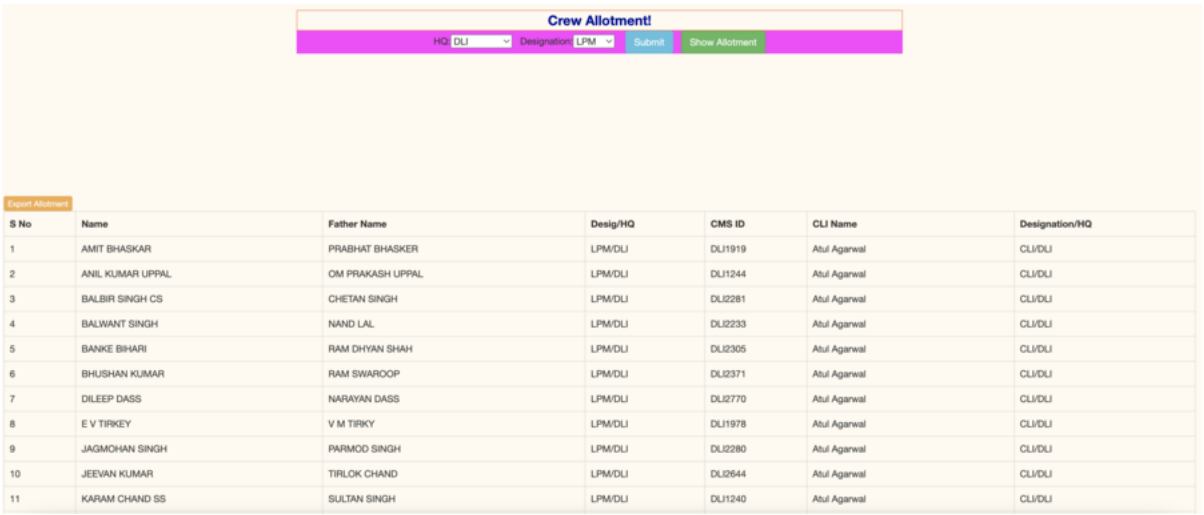
F. Crew Allotment Module:

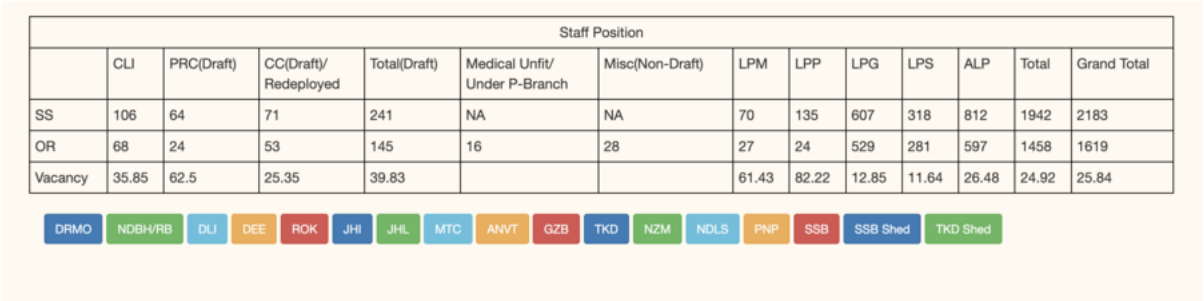
This module provides allotment of Train Crew to a Chief Loco Inspectors who is overall responsible for monitoring performance of Loco Pilot/Astt. Loco Pilot. This module facilitates easy management of distribution of Train Crew among a group of Chief Loco Inspectors.



S No	Name	Father Name	Desig/HQ	CMS ID	CLI Name	Designation/HQ
1	AMIT BHASKAR	PRABHAT BHASKER	LPM/DLI	DLI1919	Atul Agarwal	CLI/DLI
2	ANIL KUMAR UPPAL	OM PRAKASH UPPAL	LPM/DLI	DLI1244	Atul Agarwal	CLI/DLI
3	BALBIR SINGH CS	CHETAN SINGH	LPM/DLI	DLI2281	Atul Agarwal	CLI/DLI
4	BALWANT SINGH	NAND LAL	LPM/DLI	DLI2233	Atul Agarwal	CLI/DLI
5	BANKE BIHARI	RAM DHYAN SHAH	LPM/DLI	DLI2305	Atul Agarwal	CLI/DLI
6	BHUSHAN KUMAR	RAM SWAROOP	LPM/DLI	DLI2371	Atul Agarwal	CLI/DLI
7	DILEEP DASS	NARAYAN DASS	LPM/DLI	DLI2770	Atul Agarwal	CLI/DLI
8	E V TIRKEY	V M TIRKY	LPM/DLI	DLI1978	Atul Agarwal	CLI/DLI
9	JAGMOHAN SINGH	PARMOD SINGH	LPM/DLI	DLI2280	Atul Agarwal	CLI/DLI
10	JEEVAN KUMAR	TIRLOK CHAND	LPM/DLI	DLI2644	Atul Agarwal	CLI/DLI
11	KARAM CHAND SS	SULTAN SINGH	LPM/DLI	DLI1240	Atul Agarwal	CLI/DLI

G. Cadre Management:

This MIS report provides real-time cadre position of all staff with details of vacancy in each cadre. It helps in planning for recruitment of ALP through RRB or departmental promotion.



Staff Position													
	CLI	PRC(Draft)	CC(Draft)/ Redeployed	Total(Draft)	Medical Unfit/ Under P-Branch	Misc(Non-Draft)	LPM	LPP	LPG	LPS	ALP	Total	Grand Total
SS	106	64	71	241	NA	NA	70	135	607	318	812	1942	2183
OR	68	24	53	145	16	28	27	24	529	281	597	1458	1619
Vacancy	35.85	62.5	25.35	39.83			61.43	82.22	12.85	11.64	26.48	24.92	25.84

H. Miscellaneous Information Related Train Crew:

This MIS report provides real-time information in respect of Grading of Train driver which is further utilized during booking of loco pilot for a particular train service.

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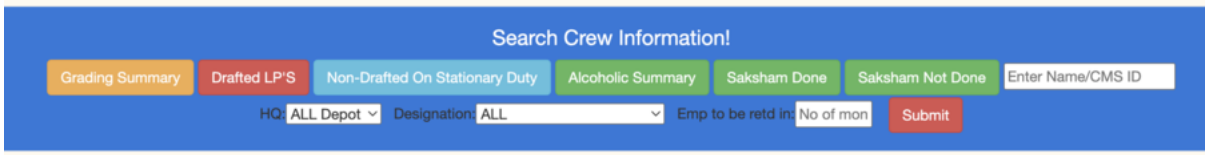
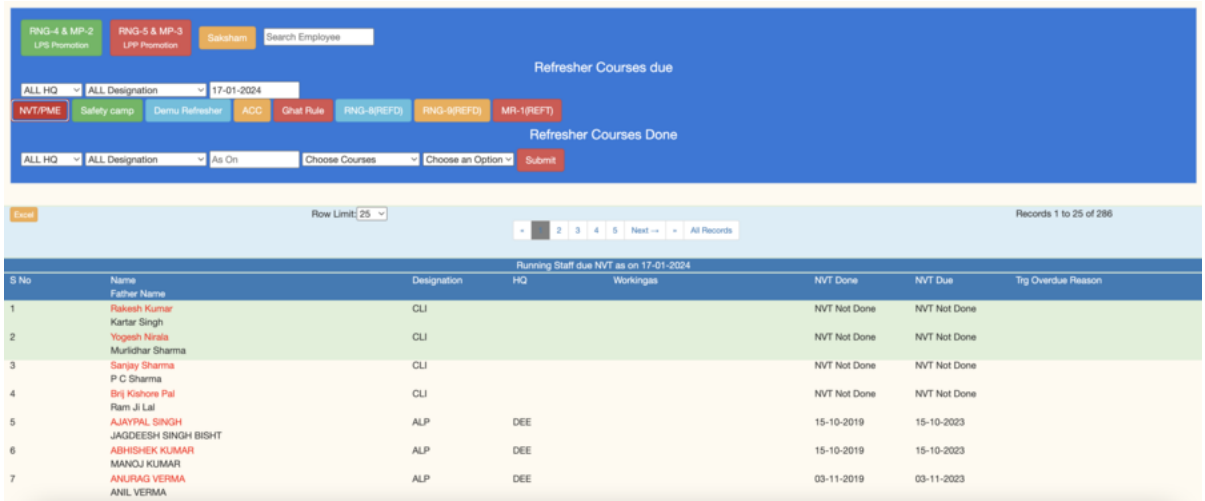


I. Training Module:

These module provides all MIS report related to training of crew due for any mandatory or refresher courses. It helps management to efficiently plan training of employee without affecting train operation.



VIII. Conclusion:

It is quite evident that the proposed resource management system shall offer numerous benefits that is likely to contribute to efficiency, safety, and overall operational excellence. Some key advantages of using the proposed system shall be real-time accessibility of critical information from any location with internet connectivity, enabling prompt decision-making and response to incidents or emergencies. Web-based record-keeping shall allow for a centralized database, ensuring that information is consistent and up-to-date across various departments and locations.

Maintenance schedules, repair history, and other crucial data can be easily managed and accessed, facilitating proactive maintenance planning. Efficient allocation of resources, including personnel and equipment, can be achieved through real-time monitoring and analysis of data related to train schedules, track maintenance, and other operational aspects.

Web-based systems can help in tracking and ensuring compliance with safety regulations, maintenance standards, and operational protocols. Web-based record-keeping shall also allow for the collection and analysis of performance metrics, enabling railways to identify areas for

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improvement and optimize operations. These historical data can be used for trend analysis, helping railways make informed decisions for future planning and resource allocation.

Thus, moving to a web-based system shall reduce reliance on paper, leading to cost savings associated with printing, storage, and manual data entry. Also, improved data analysis and reporting can lead to more effective resource allocation, reducing unnecessary expenses.

Therefore, by leveraging web-based Resource Management System for Monitoring of Pre-Departure Detention (PDD) & Critical information related to Loco Pilots/Astt. Loco Pilots, Railways can enhance the operational capabilities, improve safety standards, and provide a more reliable and efficient service to passengers.