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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.

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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

Introduction

Indian Railways (IR) manages the fourth largest national railway system in the world by size, having a total route length of 68,155 km, running track length of 102,831 km and track length of 128,305 km as of 31 March 2022.

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.

However, due to wastages of Train Crew due to non-availability of path (platform/line), the trains have to wait at outer signal or the adjacent station until the platform is vacated by pre-occupied trains.

The platform could be occupied by trains due to their stoppage at the stations, non-availability of adequate stabling/pit lines, non-availability of clear path further, late start of trains from the platforms due to reasons such as non-availability of locos, crew etc.

The pre-departure detention to the Crew, Crew hours balancing, rescheduling of Locos and Yard detentions to Locos are thoroughly monitored by the Lobby and remedial measures taken.

Quick decision-making can help optimum utilization of train crew, reduce lesser detention of freight trains for want of crew, improve safety, and optimize resource utilization.

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.

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, 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.

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]:

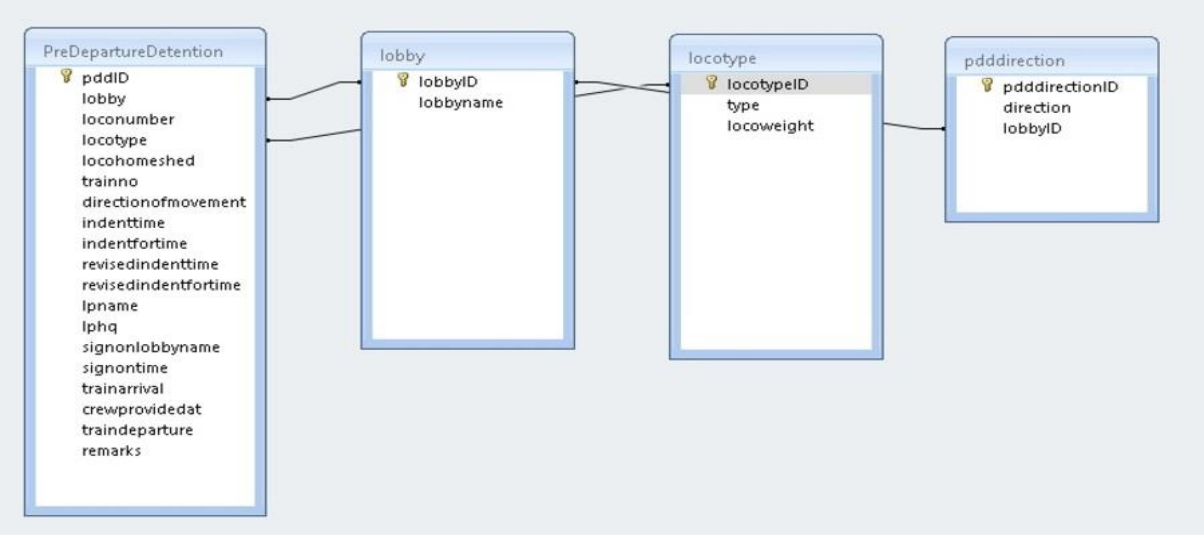
1. **Open Source**: PHP is open-source and free to use and distribute, which makes it an attractive choice for businesses and developers who are working on a tight budget. Being open-source also means that developers have access to the source code and can modify and customize it to suit their needs. This makes it cost-effective for businesses and developers.
2. **Platform Independence**: PHP is platform-independent, meaning it can run on various operating systems, including Windows, Linux, macOS, and others. This provides flexibility in deployment.
3. **Ease of Learning**: PHP has a simple and easy-to-understand syntax, making it accessible for beginners. It shares similarities with C and other programming languages, making the learning curve smoother for developers.
4. **Scalability**: PHP is highly scalable and can handle large amounts of traffic and data. It is designed to work well with databases and can be easily integrated with other technologies and platforms, making it an excellent choice for building complex web applications that can scale as the business grows.
5. **Extensive Library Support**: PHP has a vast library of extensions and modules that can be used to add new features and functionality to PHP applications. These libraries cover a wide range of topics, including database connectivity, file handling, and encryption, among others. This extensive library support makes it easier for developers to build custom applications that meet specific business requirements.
6. **Rapid Development**: PHP is well-suited for rapid application development. Its simplicity and the availability of frameworks allow developers to build web applications quickly.
7. **Integration Capabilities**: PHP can easily integrate with various databases, including MySQL, PostgreSQL, and others, enabling seamless connectivity with data storage systems.
8. **Wide Hosting Support**: Most web hosting providers support PHP, making it easy to find hosting solutions for PHP-based applications. This widespread support contributes to the ease of deployment.
9. **Support for Content Management Systems** (**CMS**): PHP is the foundation for many popular CMS platforms, such as WordPress, Joomla, and Drupal. These CMS options make it easier for non-developers to manage and update website content.
10. **Security Features**: PHP has built-in security features, and when used correctly, it can help developers build secure applications. PHP has strong security features, including built-in protection against cross-site scripting (XSS) and SQL injection attacks. It also has a variety of security-related extensions and libraries that can be used to further enhance the security of PHP applications. This makes PHP applications more secure and reduces the risk of security breaches.
11. **Flexibility**: PHP is versatile and can be used for various types of web development, including server-side scripting, command-line scripting, and writing desktop applications.
12. **Performance**: PHP is known for its high performance and speed. It can create and optimize web applications quickly, making it an excellent choice for building large-scale web applications that require high performance. Additionally, PHP can handle multiple requests simultaneously, which helps to improve application performance.
13. **Large and Active Community**: PHP has a large and active community of developers who contribute to its development and maintenance. This community provides a wealth of resources, including documentation, tutorials, and libraries that make it easier for developers to build applications in PHP
14. Compatibility: PHP is compatible with different web servers, including Apache, Nginx, and Microsoft IIS. This compatibility makes it easy to deploy PHP applications in various hosting environments.

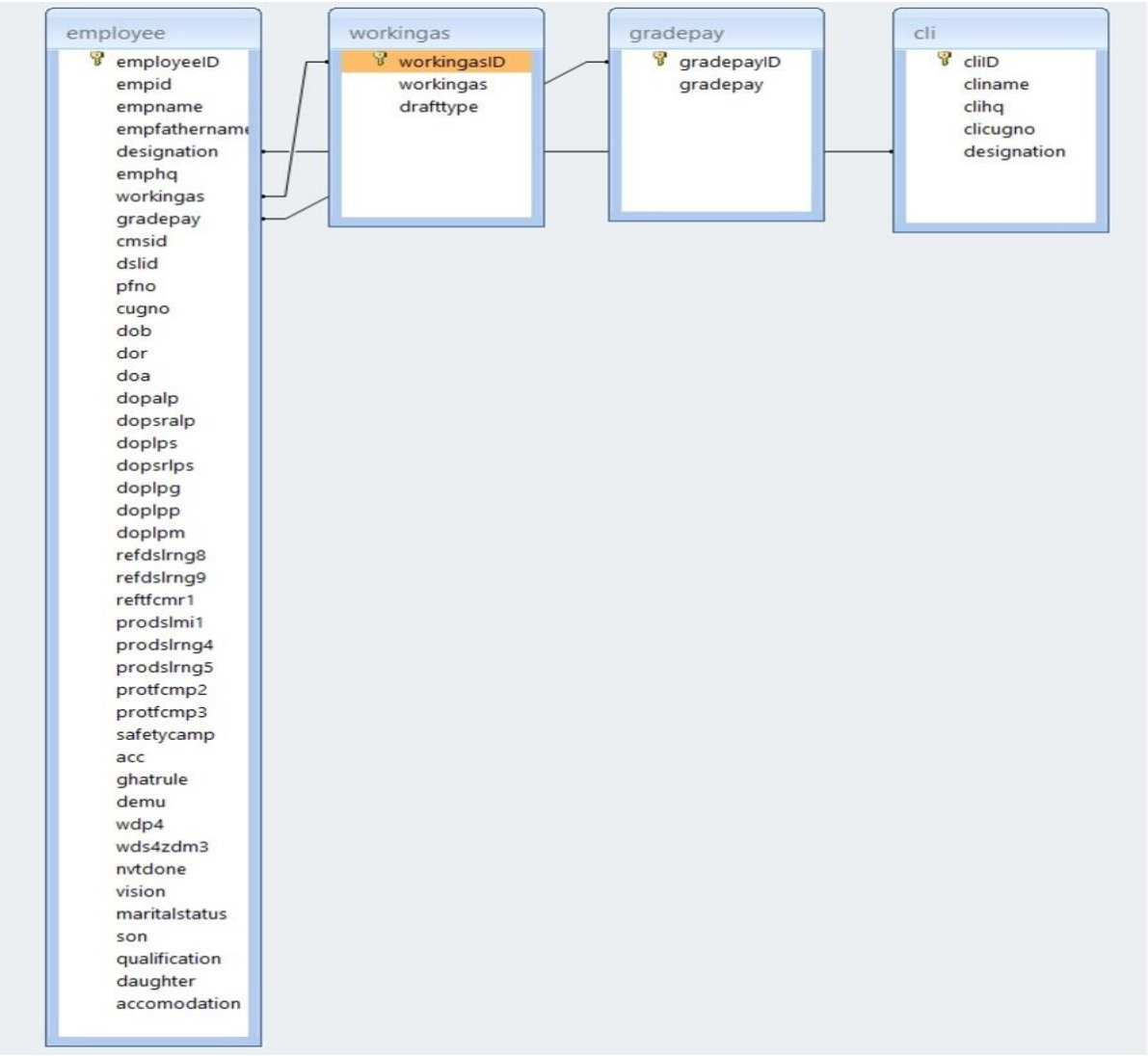
While PHP has its advantages, it's important to note that the choice of a programming language depends on the specific requirements

of a project. Each language has its strengths, and developers may choose PHP based on factors such as project scope, team expertise, and overall goals.

Process Flow of proposed system through Graphical User Interface:

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





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. ☒

Benefits of the proposed System

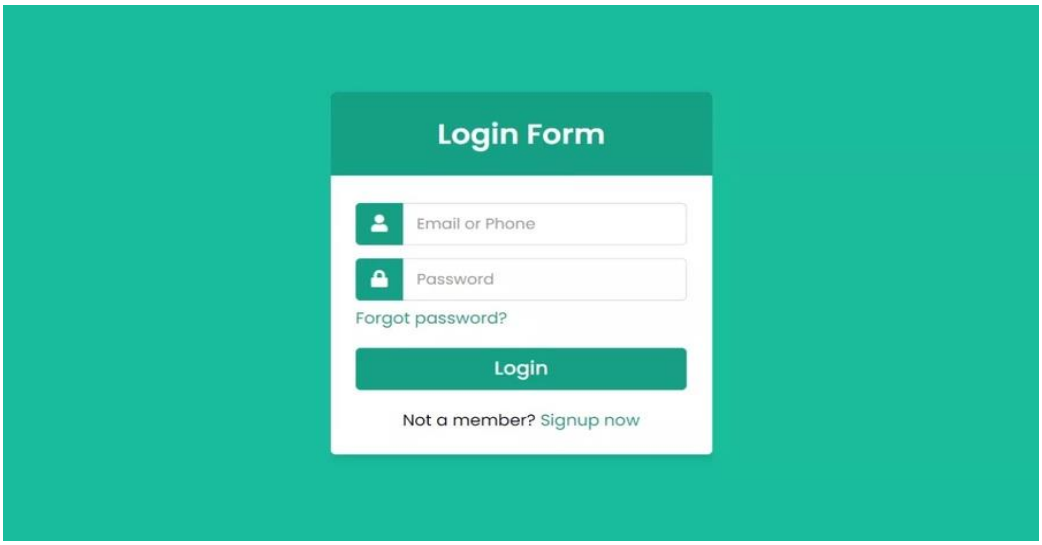
The intended benefits expected from the proposed system has been envisaged as below:

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.

Graphical User Interface:

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

User Login:

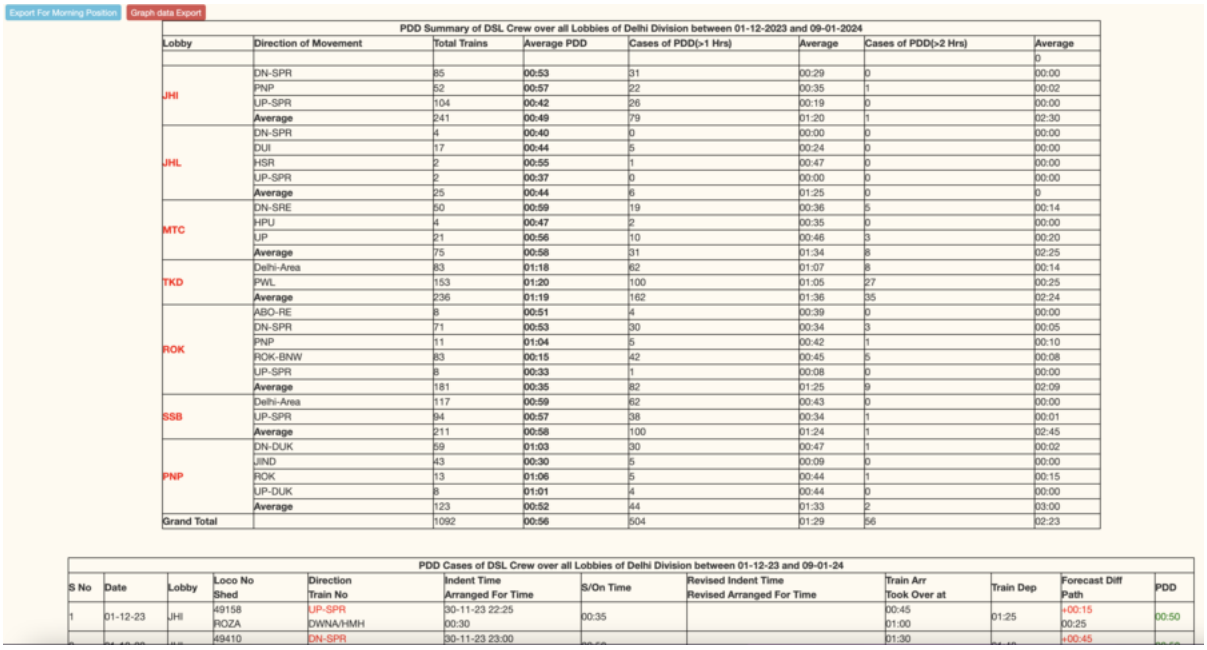


Pre-Departure Date Entry:

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

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.



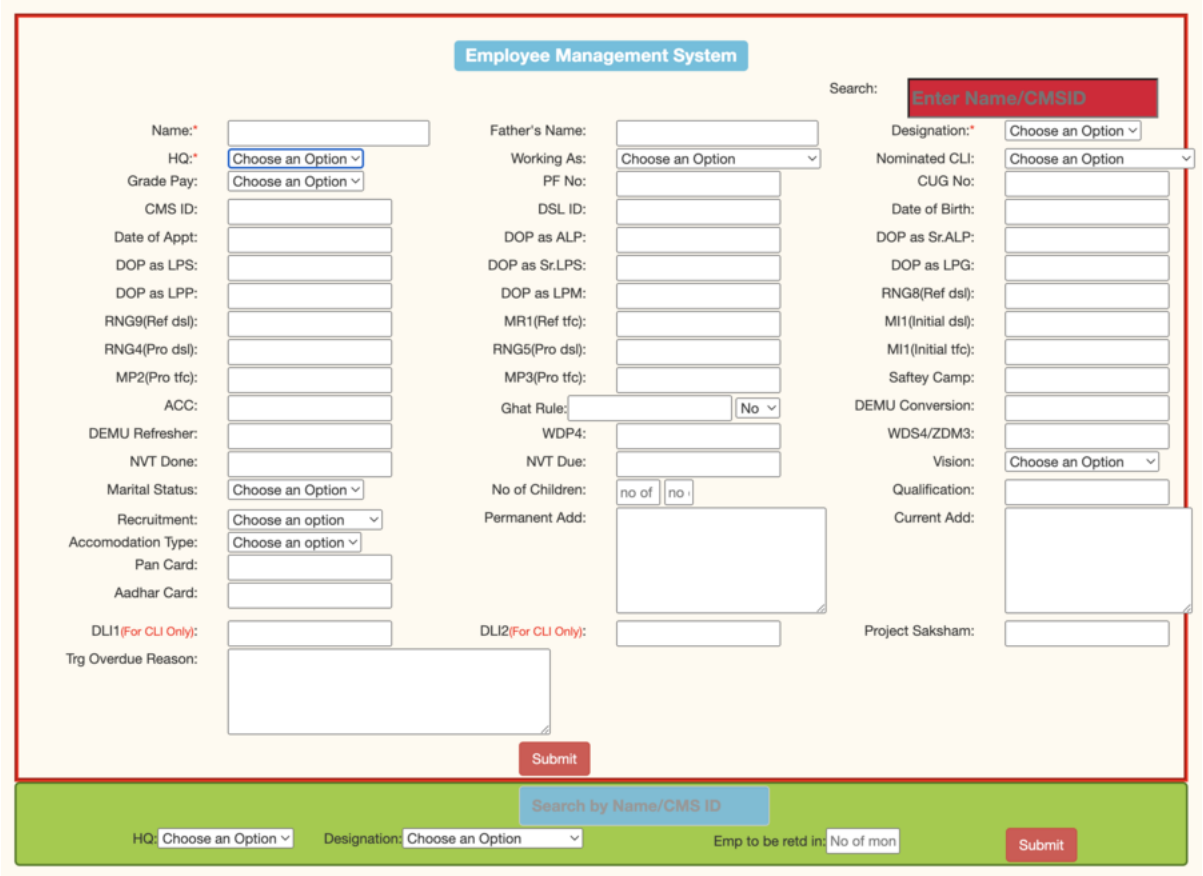
PDD Summary of DSL Crew over all Lobbies of Delhi Division between 01-12-2023 and 09-01-2024

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

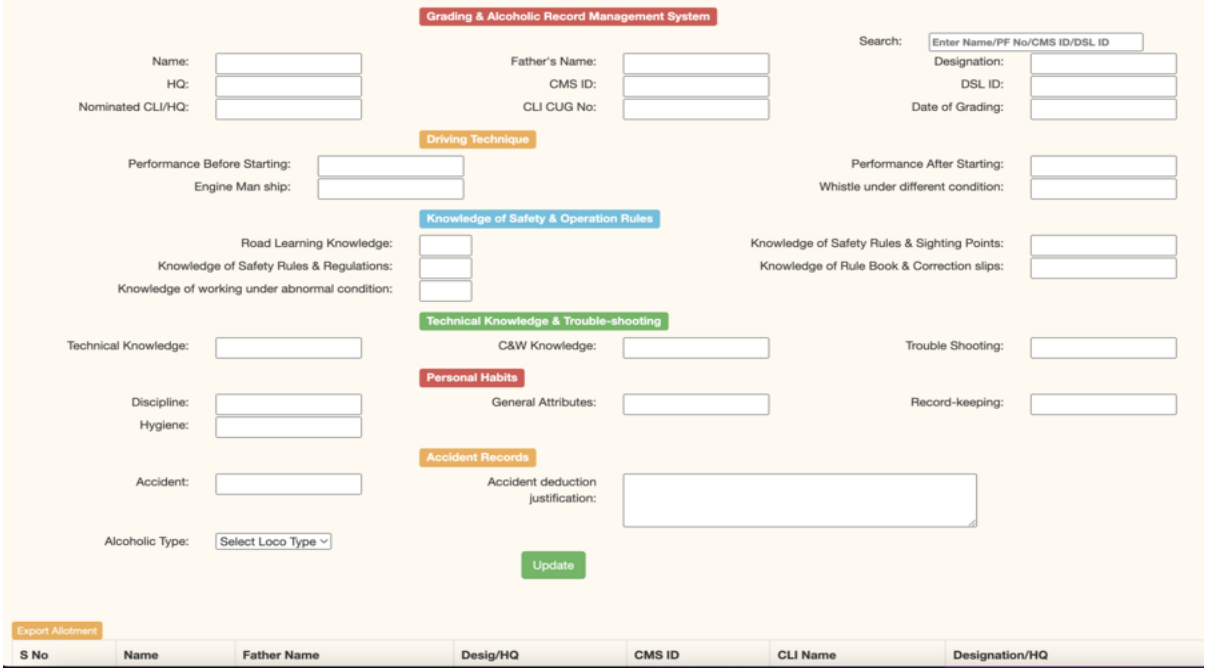
PDD Cases of DSL Crew over all Lobbies of Delhi Division between 01-12-23 and 09-01-24

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	

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.

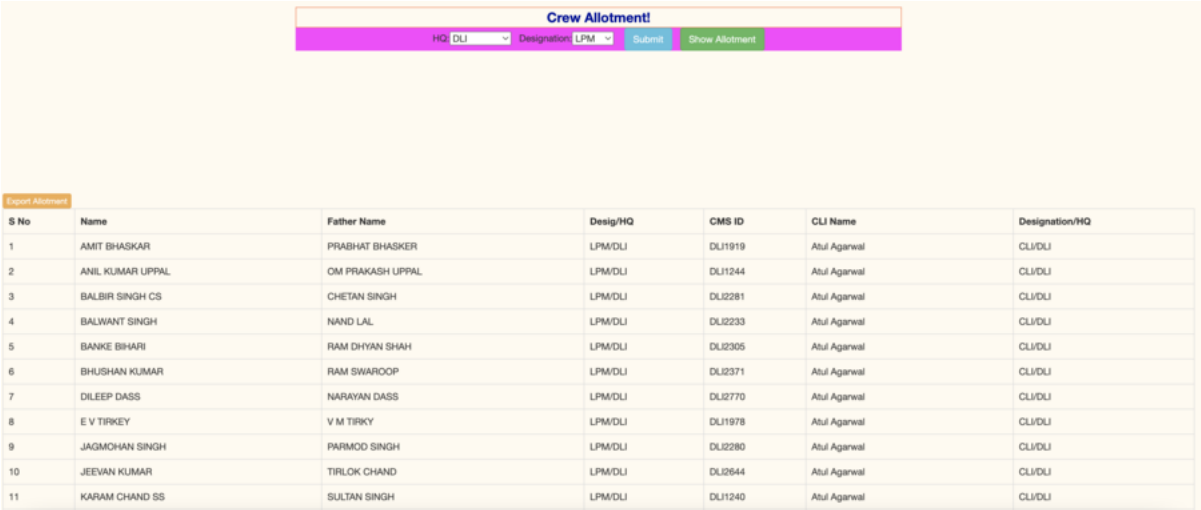


Train Crew Grading Management System: This MIS report provides real-time coach holding of a maintenance depot indicating the current status.



Crew Allotment Module:

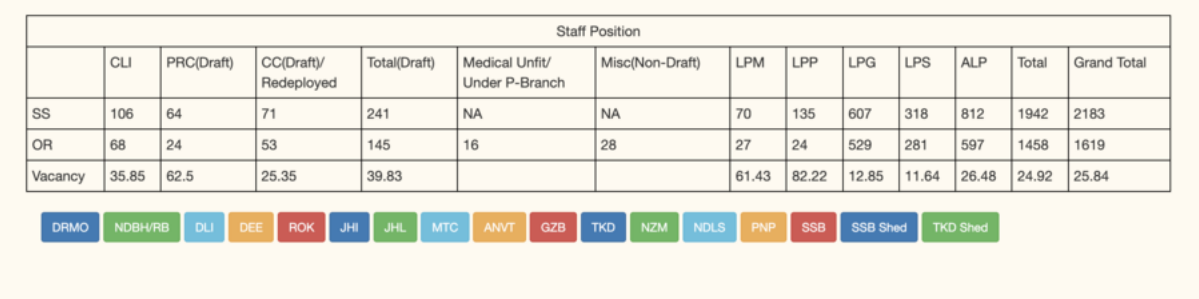
This module provides allotment of Train Crew to a Chief Loco Inspectors who is overall responsible for monitoring performance of Loco Pilot/Astt. Loco Pilot. This module facilitates easy management of distribution of Train Crew among a group of Chief Loco Inspectors.



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

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.



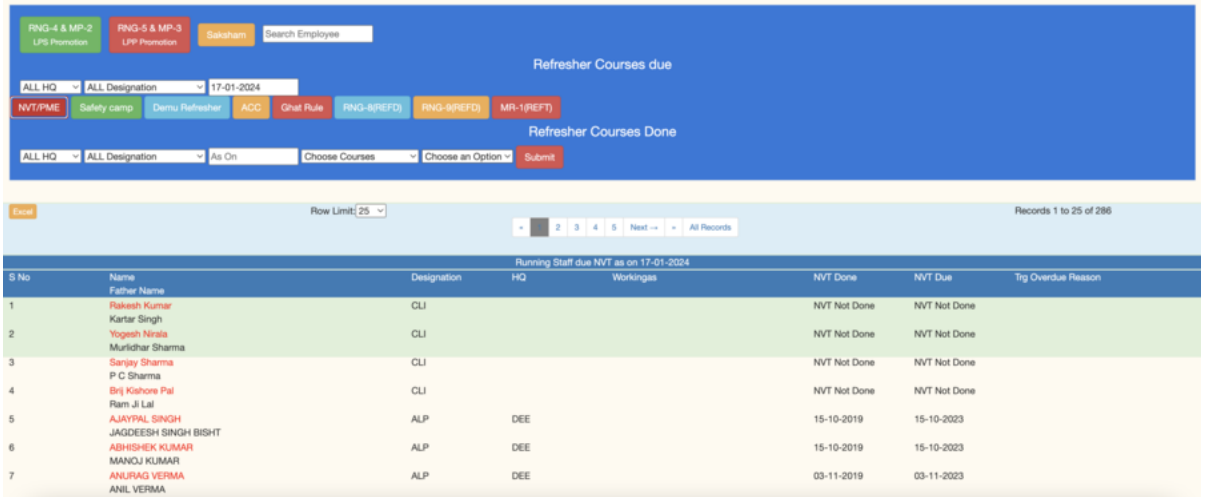
Staff Position													
	CLI	PRC(Draft)	CC(Draft)/ Redeployed	Total(Draft)	Medical Unfit/ Under P-Branch	Misc(Non-Draft)	LPM	LPP	LPG	LPS	ALP	Total	Grand Total
SS	106	64	71	241	NA	NA	70	135	607	318	812	1942	2183
OR	68	24	53	145	16	28	27	24	529	281	597	1458	1619
Vacancy	35.85	62.5	25.35	39.83			61.43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

DRMO NDBH/RB DLI DEE ROK JHI JHL MTC ANVT GZB TKD NZM NDLS PNP SSB SSB Shed TKD Shed

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.

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.



S No	Name / Father Name	Designation	HQ	Workingas	NVT Done	NVT Due	Trg Overdue Reason
1	Rakesh Kumar / Kartar Singh	CLI			NVT Not Done	NVT Not Done	
2	Yogesh Nirala / Murlidhar Sharma	CLI			NVT Not Done	NVT Not Done	
3	Sanjay Sharma / P C Sharma	CLI			NVT Not Done	NVT Not Done	
4	Brij Kishore Pal / Ram Ji Lal	CLI			NVT Not Done	NVT Not Done	
5	AJAYPAL SINGH / JAGDEESH SINGH BISHT	ALP	DEE		15-10-2019	15-10-2023	
6	ABHISHEK KUMAR / MANOJ KUMAR	ALP	DEE		15-10-2019	15-10-2023	
7	ANURAG VERMA / ANIL VERMA	ALP	DEE		03-11-2019	03-11-2023	

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 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.

References

[1] "Advantages of PHP over Other Programming Languages" Scaler.com
https://www.scaler.com/topics/php-tutorial/advantages-of-php/ (accessed January 18, 2024).