

Redesign of Loco Pilot Cabin

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R0901113004

M. Des. – Transportation Design

(2013-15)



School of Design Studies University of Petroleum
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April 2015

Redesign of Loco Pilot Cabin

Project submitted in partial fulfilment of the requirements

For the award of the Degree of

MASTER OF DESIGN

IN

TRANSPORTATION DESIGN

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Declaration

I hereby declare that the project work entitled “Redesign of Loco Pilot Cabin” submitted by me in partial fulfilment of the requirements for the award of the degree of Master of Design (Transportation Design) at School of Design Studies, University of Petroleum and Energy Studies was carried out by me during 15 Jan 2015 to 16 April 2015 at “U.P.E.S, Dehradun” under the supervision of “Manas Ranjan Mishra, Associate Design Fellow”.

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ACKNOWLEDGEMENT

This satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of the people who made it possible, whose constant guidance and encouragement crowned my effort with success.

Firstly, I would like to thank my family and friends who constantly supported me throughout the project. Special thanks to the classmates who helped me in gathering data for the project.

I would like to thank the authorities of Indian Railways who supported me in this project by allowing me to perform in depth research on Loco Pilots.

I would like to thank Ms. Shetall Naatu and Mr. Ratnish Malhotra for guiding me externally throughout the project.

I also thank my internal *guide Mr. Manas Mishra*, Assistant Professor, School of Design Studies, UPES for his valuable guidance and constant encouragement throughout the course of this project.

I also thank Dr. Kamal Bansal, Dean, COES, UPES for all the encouragement and support for this project.

ABSTRACT

Indian Railways is the largest organization in Asia running under a single management shed. Since the beginning, there have been improvements happening under many areas of it, which excludes the Loco Pilot. The Project focuses on studying the hardships of a Loco Pilot and generating the scope of it for design implications. The project involves in-depth research of the Loco Pilot's behavior in and out of the cabin. In depth research includes various factors which affect the job of a Loco Pilot, including cognitive ergonomics, physical health, working atmosphere inside the cabin, etc. Various methodologies of research i.e. Ethnographic study, Persona mapping, Mind mapping, Field Study are used here. User Centric Design methodology is being followed up throughout the project. With the help of this project, we can generate the scope for defining the solutions.

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INTRODUCTION

“Till the trains are running on the track, it doesn’t matter whether the Loco Pilot feels comfort or not, since the major priority here is to run the train and not comfort of the Loco Pilot”

- Senior Railway Management Professional



1. INDIAN RAILWAYS

Indian Railways (IR) has played a critical and historical role in weaving our huge country into a nation. Its network of over 64000 route-kms has integrated markets and connected communities over widely spread out geographies across the length and breadth of the country. In the year 2008-09, IR carried over 6900 million passengers and lifted 833 million tonnes of freight traffic, making it the third largest railway network in the world in terms of size, the world's topmost passenger carrier (in terms of Passenger Kilometres) and fourth largest rail freight carrier.

Indian Railways, are a vital force in our economy. The first railway on Indian sub-continent ran from Bombay to Thane on 16th April 1853. Fourteen railway carriages carried about 400 guests from Bombay to Thane covering a distance of 34 Km. Today, it covers 6,909 stations over a total route length of more than 63,028 kilometres. The track km in broad gauge are 86, 526 km, meter gauge are 18, 529 km and narrow gauge are 3,651 km. Of the total route of 63,028 km, 16,001 km are electrified. The railways have 8000 locomotives, 50,000 coaching vehicles, 222,147 freight wagons, 6853 stations, 300 yards, 2300 good sheds, 700 repair shops, and 1.54 million work forces.

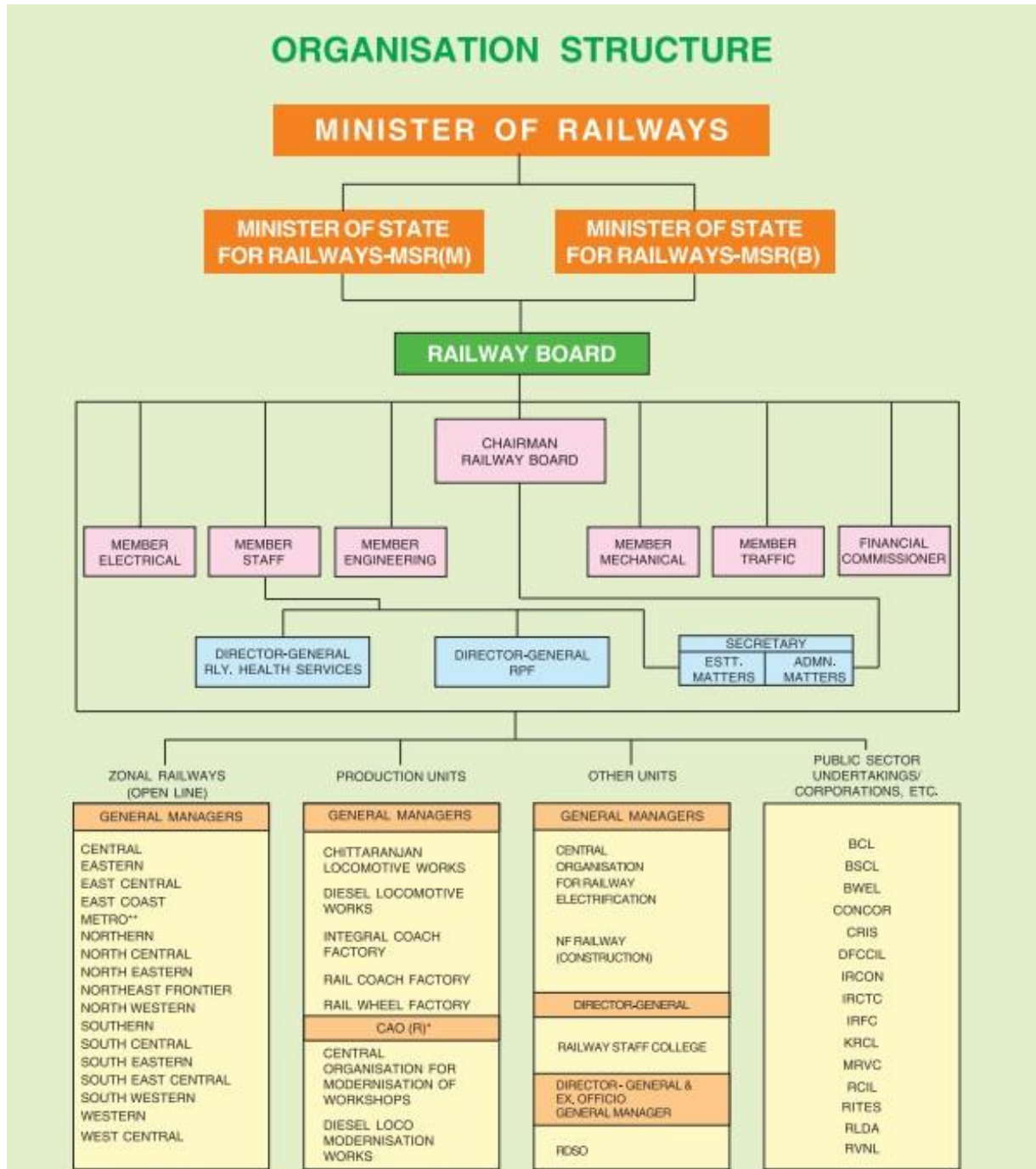
Indian Railways runs around 11,000 trains everyday, of which 7,000 are passenger trains. Presently, 9 pairs of Rajdhani and 13 pairs of Shatabdi Express Trains run on the rail tracks of India.

It is interesting to note that though the railways were introduced to facilitate the commercial interest of the British, it played an important role in unifying the country. Railways are ideally suited for long distance travel and movement of bulk commodities.

Regarded better than road transport in terms of energy efficiency, land use, environment impact and safety it is always in forefront during national emergency.

Indian railways, the largest rail network in Asia and the world's second largest under one management are also credited with having a multi gauge and multi traction system. The Indian Railways have been a great integrating force for more than 150 years. It has helped the economic life of the country and helped in accelerating the development of industry and agriculture. The Indian Railways network binds the social, cultural and economical fabric of the country and covers the whole of country ranging from north to south and east to west removing the distance barrier for its people. The railway network of India has brought together the whole of country hence creating a feeling of unity among Indians.

1. Organizational Structure



2. Indian Locomotives

Indian locomotives are considered as the blood cells of Indian railway body. The locomotives of India presently consist of electric and diesel locomotives. Steam locomotives are no longer used in India, except inheritance trains. A locomotive is also called *loco* or *engine*.

The Bengal Sappers of the Indian Army were the first to run a steam locomotive in India. The steam locomotive named 'Thomason' ran with two wagons for carrying earth from Roorkee to Piran Kaliyar in 1851, two years before the first passenger train ran from Bombay to Thane in 1853.

Diesel Traction



WDM 1



WDM 2



WDM 3a



WDM 3ar



WDM 3f



WDM 3d



WDM 3c



WDM 3b



WDM 4



WDM 6



WDM 7



WDP 1



WDP 2



WDP 3



WDP 4



WDG 5



WDM 3d



WDG 3b



WDG 2



WDS 6



WDS 4D

In India, locomotives are classified according to their track gauge, motive power, the work they are suited for and their power or model number. The class name includes this information about the locomotive. It comprises 4 or 5 letters. The first letter denotes the track gauge. The second letter denotes their motive power (Diesel or Electric) and the third letter denotes the kind of traffic for which they are suited (goods, passenger, mixed or shunting). The fourth letter used to denote locomotives' chronological model number. However, from 2002 a new classification scheme has been adopted. Under this system, for newer diesel locomotives, the fourth letter will denote their horsepower range. Electric locomotives don't come under this scheme and even all diesel locos are not covered. For them this letter denotes their model number as usual.

A locomotive may sometimes have a fifth letter in its name which generally denotes a technical variant or subclass or subtype. This fifth letter indicates some smaller variation in the basic model or series, perhaps different motors, or a different manufacturer. With the new scheme for classifying diesel locomotives (as mentioned above) the fifth item is a letter that further refines the horsepower indication in 100 hp increments: 'A' for 100 hp, 'B' for 200 hp, 'C' for 300 hp, etc. So in this scheme, a WDP-3A refers to a 3100 hp loco, while a WDM-3F would be a 3600 hp loco.

1. Classification syntaxes

The first letter (gauge)

- W – Indian broad gauge (the “W” Stands for Wide Gauge - 5 ft 6 in)
- Y – metre gauge (the “Y” stands for Yard Gauge - 3 ft or 1000mm)
- Z – narrow gauge (2 ft 6 in)
- N – narrow gauge (toy gauge) (2 ft)

The second letter (motive power)

- D – diesel
- C – DC electric (can run under DC overhead line only)
- A – AC electric (can run under AC overhead line only)
- CA – both DC and AC (can run under both AC and DC overhead line); 'CA' is considered a single letter
- B – Battery electric locomotive (rare)

The third letter (job type)

- G – goods
- P – passenger
- M – mixed; both goods and passenger
- S – shunting (also known as switching engines or switchers in the USA and some other countries)
- U – electric multiple unit (used to carry commuters in city suburbs)
- R – Railcars

For example, in "WDM
3A":

- “W” means broad gauge
- “D” means diesel motive power
- “M” means suitable for both goods and passenger service
- “3A” means the locomotive’s power is 3,100 hp ('3' stands for 3000 hp, 'A' denotes 100 hp more)

Loco Pilot-The heart of Indian Railways

Loco-Pilots are the most important person in executing the huge task of transporting nearly 25 Million passengers and more than 2.8 Million Tons of freight daily with the help of 2,29,381 wagons, 59,713 coaches and more than 9,213 locomotive engines of various kinds. To transport 25 million passengers and millions of tons of freight and that too with taking care of both the traveller's convenience and safety is not a mean task, the driver on whose sincerity the journey of a train depends. If he is not capable of carrying his responsibilities then the efforts of the other employees go waste, in this sense we can say that he is the most important person of the railways.

The job of a Railway Driver demands hard work and great presence of mind along with courage to handle diverse conditions. For this one should have discipline, patience, responsibility, punctuality, commitment, courage and above all self-confidence. The job requires lots of hard work, stamina, alertness of mind, adaptability to follow difficult time schedules too. But the main and remarkable, highly appreciable role of Railway drivers is the only who works with full honesty, in day & night, in heavy cold, hot & Rainy weather.

If Indian railways is the Body of the Nation, then Loco Pilots are surely the heart inside that body. It's a matter of ultimate shame for our governing body which doesn't seem to be interested in looking about the wellbeing and hardships of Loco Pilots of Indian railways. Indian Railways still carry the legacy left behind by the colonial masters.

The railway authorities have made all possible arrangements for the dis-comfortness of driver in the Loco Pilot Cabin. How vigorous is the job profile can be noted from this very fact that the Railway recruits persons as 'Assistant Loco Pilot'. They work on freight trains for as long as 10–12 years. During this tenure they are supposed to work with experienced Train Drivers and perform only assisting work during the run of a locomotive i.e. a train. An Assistant Driver thus learns the tactics and dos and don'ts required for train operation. Thereafter they are promoted as 'Loco Pilot Shunter', after proper courses and practical trainings, wherein they are supposed to drive locomotives in sheds/yards at not more than 15 km/h speeds. After experiencing for not less than two years, they are promoted as 'Loco Pilot/Goods', who are always monitored by their respective 'Loco Inspectors'.

A train has typical an Assistant Loco Pilot and a Loco Pilot on the Locomotive. The Assistants are normally common but Loco Pilots fall in various categories like Goods Drivers (or Loco Pilots used for running goods trains), Passenger Driver (Driver used to run slow moving Passenger carrying Trains), Mail Express Driver (Driver used to run high speed Passenger carrying Trains) and Rajdhani Drivers (Used for very high speed passenger carrying trains). There is yet another category of crew called 'Shunters' who operate only in yards, for moving trains within a particular station yard. Normally Shunters work alone without an Assistant.

The train at the rear end has Guards as its crew. They are categorised as goods guards, passenger guards and mail express guards based on the type of train on which they are working.

The job of a Loco Pilot consists of irregular rest and working hours, eating disorders, and sleep disorders. That is why the Railway spends a lot on their trainings and resting time. They are booked from a crew changing point, informed well in advance, after ensuring that

they have taken sufficient rest and completed all required trainings and requirements, those are mandatory for train operation. At the end of the journey, they are sent to well maintained rest rooms, given meals (home cooked) and rebooked back to their headquarters after giving minimum stipulated rest.

Railways' Drivers / Loco-Pilots are the most important person in executing the huge task of transporting nearly 25 Million passengers and more than 2.8 Million Tons of freight daily with the help of 2,29,381 wagons, 59,713 coaches and more than 9,213 locomotive engines of various kinds(www.Indian railways, Wikipedia).To transport 25 million passengers and millions of tons of freight and that too with taking care of both the traveller's convenience and safety is not a mean task, the driver on whose sincerity the journey of a train depends. If he is not capable of carrying his responsibilities then the efforts of the other employees go waste, in this sense we can say that he is the most important person of the railways. The job of a Railway Driver demands hard work and great presence of mind along with courage to handle diverse conditions. For this one should have discipline, patience, responsibility, punctuality, commitment, courage and above all self- confidence. The job requires lots of hard work, stamina, alertness of mind, adaptability to follow difficult time schedules too. But the main and remarkable, highly appreciable role of Railway drivers is the only who works with full honesty, in day & night, in heavy cold, hot & Rainy weather. For Railways' drivers operating on long distance routes, overnight stays in various locations will be necessary. Furthermore, it can be stressful, as delays and hazards on the track are not uncommon. His cab of the train should be relatively comfortable but it may be quite cold, hot and noisy.

2. DATA COLLECTION

1. *Secondary Research*

The work of Indian railways' drivers is considered as extremely stressful. It is working in an environment over which they have no control whatsoever and is an atmosphere that wrecks their schedules, disrupts their home life, makes social activities and regular breaks very hard to plan. This paper deals with the working conditions of Indian railways' drivers and the factors that lead to a fatigue and stress, causing high probability of accident. This review of literature deals with the working conditions of an Indian railways' drivers which is having very high importance on their total wellbeing and hence their productivity and entire growth and safety of an Indian railway.

1. Indian Railways' Driver

The work of the railway driver is demanding and full of responsibility. The railway driver is in- charge of both safety and punctuality, a job which requires a high level of concentration and alertness. The extremely irregular working hours constitute an added workload for the railway driver. The physical work environment can also give rise to workload; this includes, for e.g. noise (or distressful noise levels), vibrations or an uncomfortable cab conditions (too hot, too cold, draughty). The railway driver is also exposed to a demanding psychosocial work environment, which includes solitary work, limited opportunities for social contact and a heavy responsibility for operating the train (in terms of both safety and adhering to the timetable). The railway driver's job, i.e. to operate the train, is largely governed by timetables and technical conditions (e.g. type of train, track area), which restricts the driver's ability to decide for himself how the job is to be done. Railway drivers struggle to fulfil work and family responsibilities. This struggle is due to

hours, irregular and inflexible work schedules, and heavy workloads. Thus, work–family conflict can be a common work stressor for railway drivers.

1. Nature of Duty

The job of a Railway Driver demands hard work and great presence of mind along with courage to handle diverse conditions. For this one should have discipline, patience, responsibility, punctuality, commitment, courage and above all self-confidence. The job requires lots of hard work, stamina, alertness of mind, adaptability to follow difficult time schedules too. But the main and remarkable, highly appreciable role of Railway drivers is the only who works with full honesty, in day & night, in heavy cold, hot & rainy weather.

2. Loop Holes in Existing System

The driver doesn't know anything about what's going around. He doesn't have any information about other trains. His only job is to see a signal aspect and follow that. And the signal aspect depends upon the Station Master, so if Station Master gives wrong signal and gives wrong route accidents occur. Whole working is Station Master dominant. The driver cannot take any decision. In fog or worst weather condition driver can't able to see the signal and the situation would lead to accidents. (Anjali Jain et al; 2013)

1.4 Life after the Duty/Job: When railway drivers at outstation duty, after signing off his duty, railway driver stay in the running room located near by the station premises. He carry himself rations, vegetables etc. for cooking meals in the kitchen of running room. Because in running room no any cooked food served around the clock. Only cooks are available for preparing the food. Due to shortage of cooking staff(generally 2-3 staff working) in running room, sometime cook taking 3-4 hours for preparing food (rules to served within 45 minutes). So, they are unable to get more than 10-12 hours of rest even as they are provided 16 hrs. rest.

After the meal normally he goes to sleep immediately, because due to high speed and continuous running train Loco-Pilots are extremely tired. Relatively same condition at home station. 100% housing should not be provided to drivers as they are residing up to 5-6 KMs. away from their station of posting and are taking a lot of time in commuting. They are unable to get more than 10-12 hours of rest even at home station when they are provided 16 hrs. rest. After the meal normally he goes to sleep immediately, because due to high speed and continuous running train Loco-Pilots are extremely tired.

3. Railway Driver Career Prospects

A Railway driver usually begins his career as a diesel or electric assistant driver, where his job is mainly to check the state of the locomotive, help with all the auxiliary equipment as needed, and to call out the aspects of the signals. ALP with minimum 2 years of service as Diesel Asstt. /Electric Asstt. and 60,000 Kilometer running experience is required for the promotion to the post of Loco-Pilot (Goods). An assistant driver works as an assistant on goods trains, then on passenger trains, and finally on express trains. It takes at least 8 or 10 years, usually more, before an assistant driver works up the ranks to become the driver for a Rajdhani or Shatabdi train.

4. Working Conditions

At present Loco Pilots are classified under 'continuous' roaster. Not any calendar day rest provision. Normally the Loco Pilot has to work for 10 hours duty at a stretch and can demand relief after 12 hours with 2 hours prior notice to controller.

Cab Conditions

The heavy noise, dust pollution, excess heat, high voltage electricity in the electric locomotive and diesel smell in the diesel locomotive are contributing to early fatigue to the crew. The noise level in a diesel locomotive is about more than 100 decibels which is 25 decibels more than maximum allowed limit of 75 decibels by the Industrial Pollution Control Board. The heat, diesel smell, noise from the engine room comes to the driving cab as the doors in the driving cab are not designed sound proof. To overcome this problem the locomotive cab has to be air-conditioned so that fatigue will not attack the drivers and they can concentrate on their duties properly and ensure safety of trains. No natural Call facilities.

Periodic rest of Loco pilots

At Headquarters:	
For duty less than 8 hours	12 hours
For duty of 8 hours or more	16 hours
At Outstation:	
8 hours rest for 8 hours running duty or more.	

Running Room

Running Room is situated around the station premises, in which Loco-Pilots taking rest after the duty. In running room, normally dormitory so loco pilots getting disturbance of sleep when other crew members or call boy are coming or getting ready for duty and putting lights etc. Due to high temp Loco-Pilots not enjoyed fully undisturbed sleep before running trains. Because, generally no air-conditioning provided

He carry himself rations, vegetables etc. for cooking meals in the kitchen of running room because in running room no any cooked food served around the clock. Only cooks are available for preparing the food. Due to shortage of cooking staff (generally 2-3 staff working) in running room, sometime cook taking 3-4 hours for preparing food. So, they are unable to get more than 10-12 hours of rest even as they are provided 16 hrs. rest.

Medical Facilities: Paternity leave for 15 days only two times during the whole service periods. Paternity Leave may not normally be refused. Leave cannot be sanctioned for more than 5 years continuous.

Medical leave : - During one year

10 days with full pay.

20 days with half pay.

More than 20 days without pay.

When Railways' drivers joining after six months of medical leave, Railways' authority take a full/complete medical test. If found medically not fit, duty/job/post of Loco-Pilot can be changed.

5. Personal/Family Related Problems

Loco-Pilots are not giving (spending) more (sufficient) time with his family and societal activities.

100% housing should not be provided to drivers as they are residing up to 5-6 kms. away from their station of posting and are taking a lot of time in commuting. They are unable to get more than 10-12 hours of rest even at home station when they are provided 16 hrs. rest.

All other railway employees get 12 National Holydays and 52 Sundays, guaranteed weekly rest but Loco-Pilot does not get any National Holyday. So, all the personal work has to be done by availing leave, or between short spells in between duties, which creates mental agony, losing concentration in running duties. No any calendar day rest provision, so that they may fulfill their family and social obligations.

2. *Review of the Literature on Railway Drivers*

There are relatively few published literature (studies) available on Indian railways' drivers working conditions. So, researcher has included studies of other nations that are relevant to this research. A Swedish study (Kolmodin-Hedman and Swensson, 1975) finds out, that the irregular working hours disrupted the drivers' sleep in connection with night and early morning duties. There were also reports that the working hours intruded upon railway drivers' social lives and led to problems of sleep and fatigue. The most unpleasant working hours were the night and early morning duties, which were regarded as providing too little time for rest and recovery. The best working hours were those that started after 7.00 a.m. or that involved afternoon and evening work. Finally, this study too showed that Irregular working hours was perceived as one of the most serious problems at work. One of the worst causes of stress that a railway driver can be exposed to is that of running over and killing or seriously injuring a person.

A Japanese study (Kogi & Ohta, 1975) has analysed near-accidents/accidents and their relation to sleepiness, and found that approximately 17 percent of incidents were sleepiness-related.

A Finnish study (Hannunkari,1978) and a Danish study (Netterstøm,1981) also show that irregular working hours are a major problem for train drivers as well as their physical work environment. Working hours, in particular night duties and long hours following an early morning start were also a major problem. High mental demands at work, such as intense concentration and continual alertness, were also felt to be psychologically demanding. American accident investigators at the NTSB (the National Transportation Safety Board) have reported some very serious train accidents in which the driver had fallen asleep

because of a strenuous schedule, an accumulated lack of sleep and, in certain cases, drug abuse (Lauber & Kayten, 1988).

A German study (Myrtek,1994) has, examined railway drivers' perceived mental workload and heart rate variability. They found that when driving monotonous stretches at high speeds, the drivers' heart rate variability decreased something that is considered to be a sign of increased mental workload and stress. However, according to (Heitmann,1997), drivers have very strenuous (irregular and long) work, with regular micro-sleep events during the night.

An Australian study (Edkins & Pollock, 1997) has classified more than 100 railway accidents and near-accidents. The most significant accident factor in this study was the lack of alertness (e.g. meaning that critical signals were missed). They go on to discuss that this is probably related to the high degree of monotony in the railway driver's work. (Dawson et al, 1998), find that railway drivers suffer from severe fatigue and sleepiness when working at night. It is not at all uncommon for railway drivers to skip sleep during the day (or take just a short nap) after a night-time duty. Performance (tested with a 3 minute "tracking" test) was also at its lowest at around 2 to 3 a.m., while a short sleep (less than 5 hours), or a short period of rest before the duty, resulted in increased sleepiness at work.

European studies (A. G. Stoynev and N. K. Minkova, 1997) show that excessive fatigue resulting from overtime work is a potential additional factor which may contribute to increased accident rates. The work load of truck drivers was significantly greater than that of the control ATC group. This was combined with less leisure time and less sleep. These factors are known to produce excessive fatigue and an increased accident rate. An Indian study (Ram Chandra Acharya, 1997) show that the total population of India has increased by 350% since early this century, but its urban population has shot up by 840%. As a result,

metropolises, cities and towns have sprawled out, engulfing nearby villages or smaller townships and converting them to suburbs. The teeming populations of these satellite towns, where housing was available at reasonable prices, has no choice but to commute long distances, thereby throwing an increasing burden on road and rail. Since rail transport is a vital development area in any city's infrastructure, it continues to play a key role in transportation, especially in the cities of India.

A Swedish study (L.Kecklund,2001) has, examined the train drivers' work situation, stress, workload and work hours: Stress and work load: The results show that the drivers experience more stress, worse sleep quality, more sleepiness and lower job satisfaction and also more social problems (with family) than other comparable groups. The results indicate that the risk of the drivers developing chronic stress and fatigue is high (Ingre, et.al. 2000). Work hours: The drivers' work hours were highly irregular. Stress, sleepiness, fatigue and sleep disturbances were related to a higher frequency of self-reported, work-related errors. Sleepiness and lack of job motivation were the most important factors explaining serious mistakes at work.

1. Causes of Sleepiness, Fatigue and Workload

1. The Circadian Rhythm

Problems related to working hours changes are primarily caused by our biology, in that our circadian rhythm is set for rest and sleep at night and for activity and high functionality during the day. Most features of our biological (e.g. hormones, body temperature) and psychological (e.g. level of alertness, mood, performance capacity) make up a pronounced circadian rhythm whereby activity is low at night and high during the day (Åkerstedt et al, 1979). For example, wakefulness (sleepiness) and body temperature levels reach their absolute minimum during the early morning hours, between 3 to 5 a.m., at which time our bodies are programmed to sleep and when it is most difficult to wake up (Dijk & Czeisler, 1995). The circadian rhythm is controlled by a biological clock in the brain, which is sensitive to the changing patterns of light and darkness, in that darkness signals inactivity and rest while light signals activity (Czeisler & Dijk, 1995).

2. Stress and Mental Workload

The actual job of driving a train generates a mental workload by virtue of the constant demands to concentrate and monitor, and on the driver's readiness to handle unexpected operational conditions (e.g. technical disruption). Railway drivers are also subject to stress arising from factors not related to the actual driving, such as working hours and lack of sleep. They can suffer from both physical stress (e.g. noise and vibrations) and psychosocial stress (e.g. fast working pace and concern about accidents).

Stress

Stress in its negative sense implies an imbalance between the demands of the environment and the capacity of the individual to cope, or that the individual's expectations exceed what is offered by the environment. If a stress situation cannot be controlled, negative reactions arise such as discontent, worry, fear, frustration, and a lack of pleasure or motivation at work. Physiological responses, e.g. increased release of stress hormones, higher blood pressure, a more rapid heart rate, and a rise in blood fat levels are also linked to stress (Theorell, 1997). If this condition is allowed to continue over a period of time, stress can lead a state of exhaustion, burnout and illness. Suffering from burnout entails a constant state of physical and mental exhaustion or extreme tiredness. Considering now the workload of the railway's drivers, working hours can probably be seen as the most serious stress factor. The relatively limited opportunities to influence working conditions can also be a major source of stress.

Mental Workload

The concept of mental workload originates from the "human factors" field. It involves analysing the interplay between the capacity of the operator/individual, the demands of the job and of the ergonomic work environment. Mental workload is principally a matter of human mental abilities, of how information is received and processed, and the decisions and measures to which this leads. A high mental workload can result from an abnormally high pace at work. And if this continues over a long period of time, there is considerable risk that conditions of stress will arise. The circadian rhythm, lack of sleep and sleepiness influence performance ability. Cognitive functions (e.g. reaction time, vigilance and short- time memory) deteriorate late at night and when lacking sleep. If a further lack of sleep

occurs, performance levels deteriorate during the day as well. Results concerning the train drivers' work situation, stress, workload and work hours:

The results show that the drivers experience more stress, worse sleep quality, more sleepiness and lower job satisfaction and also more social problems (with family) than other comparable groups. The results indicate that the risk of the drivers developing chronic stress and fatigue is high.

3. Work hours

The drivers' work hours were highly irregular. Stress, sleepiness, fatigue and sleep disturbances were related to a higher frequency of self-reported, work-related errors. Sleepiness and lack of job motivation were the most important factors explaining serious mistakes at work.

2. Summary of Earlier Studies

1. **Working Hours:** Earlier research has highlighted above all the problems of irregular working hours. Night and early morning shifts are known to be associated with high sleepiness and inadequate recovery, but it is not fully clear whether this affects safety and leads to more accidents.

2. **Physical Work Environment:** Most studies have shown that railway drivers feel that they have a strenuous physical work environment.

3. **Psychosocial Work Environment:** Very little research has been done concerning railway drivers in this field, particularly in terms of work-life balance.

4. **Accident Research:** By far the most common method used is an analysis of surveys and registered accident data. A few studies have investigated physiological activity related to sleep/wakefulness and stress.

5. **Total Scheduling Workload:** As far as working hours are concerned. One question of interest is whether an extremely heavy schedule (a dense schedule with frequent morning and nighttime shifts) can lead to chronic fatigue and burn out.

6. **Differences between Different types of Train Traffic:** One observation is that previous studies make no comparison between different types of traffic. Most of the earlier research is focused on long-distance and high-speed trains, while few studies have investigated commuter train traffic. The differences in traffic density (low versus high), stress, fatigue and safety have not been studied.

In summary, after reviewing of literature identified that Indian railway drivers had difficulties in balancing work, life, and social activities. The findings from this study suggest that contending with stressful situations in the workplace is a common occurrence for the railway drivers leading to deterioration in their quality of work and life. These are the important reasons to assume that sleepiness and stress reduce a railway driver's mental capacity when work load reach its peak. In this context, it was found that railway drivers are exposed to a range of stressors such as the poor ergonomic cab conditions, distressful noise, uncomfortable climate conditions, and work scheduling, resulting in poorer health and work performance.

3. USER RESEARCH

After the literature survey, the researcher moved on to user survey and User study to gather the practical insight of the scenario.

Several list of Questionnaires were prepared for different kind of Users which include the grade from Assistant Loco Pilot to the Loco Inspector.

The responses were recorded in the audio as well as video format and are preserved in the Project CD. Most of the users have joined railways without appearing for any exam or test.

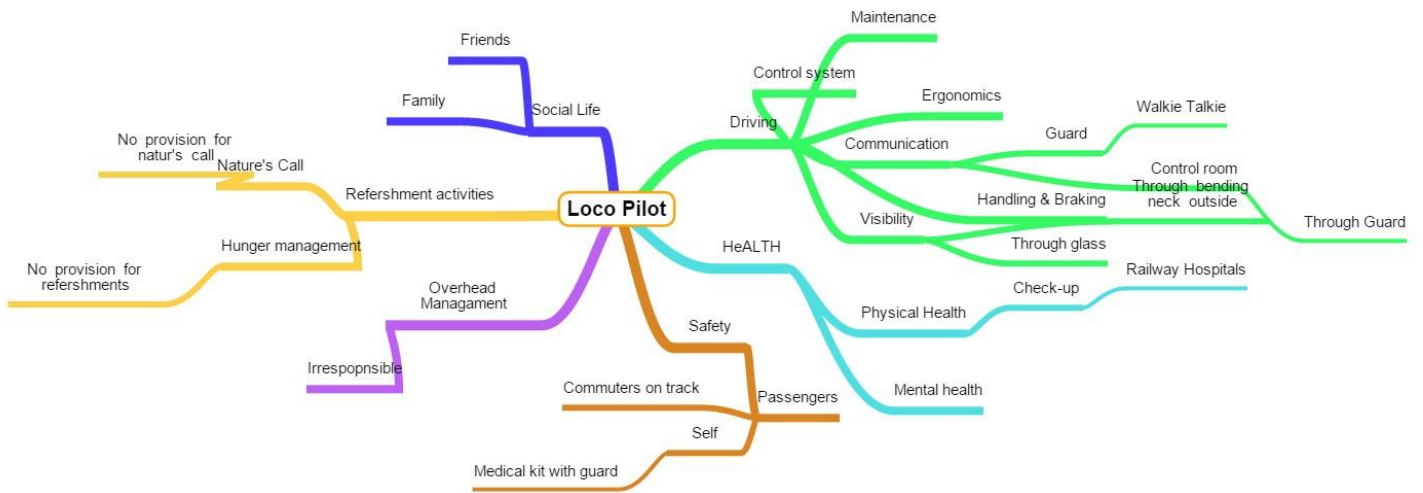
Further details are provided as follows.

1. User Interviews

Users Interviewed

Name	Age	Marital status	Experience (Years)	Designation	Qualification	Training (Months)	Reason behind joining this job
R.D Sharma	40	Married	15	Loco Pilot	B.Sc, ITI diesel mechanics	15	Job Crisis, Wanted to make future in Technical field
Raj Kumar	55	Married	25	Asst. Loco Pilot	High School	6	Poor financial condition, Need of job
Sampooranand	34	Married	2	Asst. Loco Pilot	ITI	5	Wanted to clear government exams, got through this one
Dhanesh Kumar	34	Married	2	Asst. Loco Pilot	ITI	5	Job Crisis, wanted to clear government exams
Ram Murthy	55	Married	7	Loco Pilot	S.S.C	3	Poor financial condition
Krishna Ojha	30	Married	3	Asst. Loco Pilot	B. Com	6	Personal reasons
Virendra Kumar	56	Married	28	Loco Pilot	S.S.C	3	Followed family tradition
Hemant Joshi	53	Married	22	Loco Pilot	Diploma	3	Passionate about job
Surendrakumar	28	Married	2	Asst. Loco Pilot	Diploma	9	Passionate about clearing competitive exams
Mahesh Singh	45	Married	20	Loco Pilot	Diploma	4	Poor family condition
H.J. Joshi	58	Married	18	Shunting Pilot	8th Pass	3	Enthusiast for serving the nation

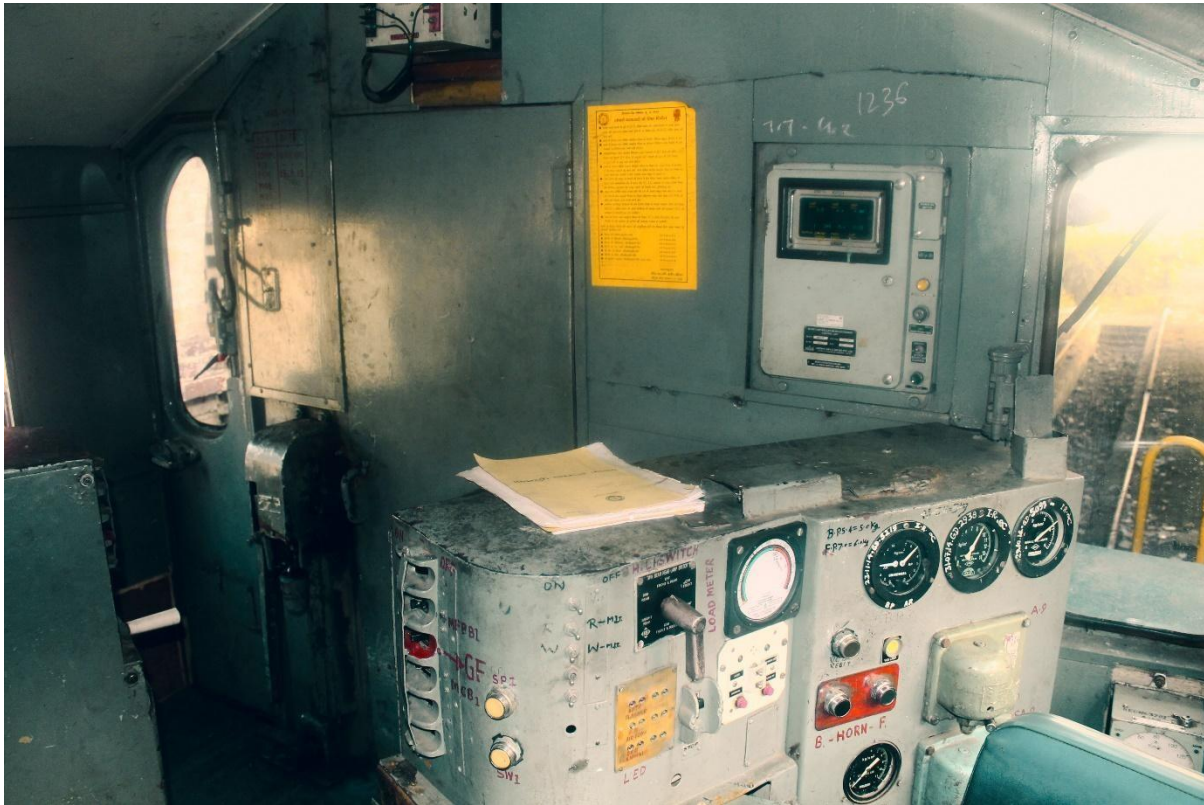
2. Mapping of Loco Pilot's life while driving



Loco Pilot-New Delhi-Dehradun Shatabdi Express on Duty



3. Cabin of One of the Latest Engine of Indian Railways



Important Controls of Loco Pilot

Digital display includes speedometer, brake oil level, etc

Throttle

Sander

Engine light switch

Brake

Circuit breaker

Horn

User Study- A day with the Loco Pilot

Train- Dehradun Amritsar Lahori Express



■ Duty of Asst. Loco Pilot

- Examine the engine before and during its run.
- Communicate the upcoming signal to the Loco Pilot.
- Frequently blow horn to alert the external environment as per the needs.
- Prepare snacks for both of them.
- Communicate with guard by waving flag/torch light.
- Keep an eye on the operations of Loco Pilot else press the VCD control button in 60 seconds.
- Keep an eye and communicate the same to the loco pilot about the signage coming ahead on track.

■ Duty of Loco Pilot

- Guide the Asst. Loco Pilot as and when needed explaining technical features.
- Constantly have a look on the track.
- Drive the Engine.

■ Hardships of Asst. Loco Pilot

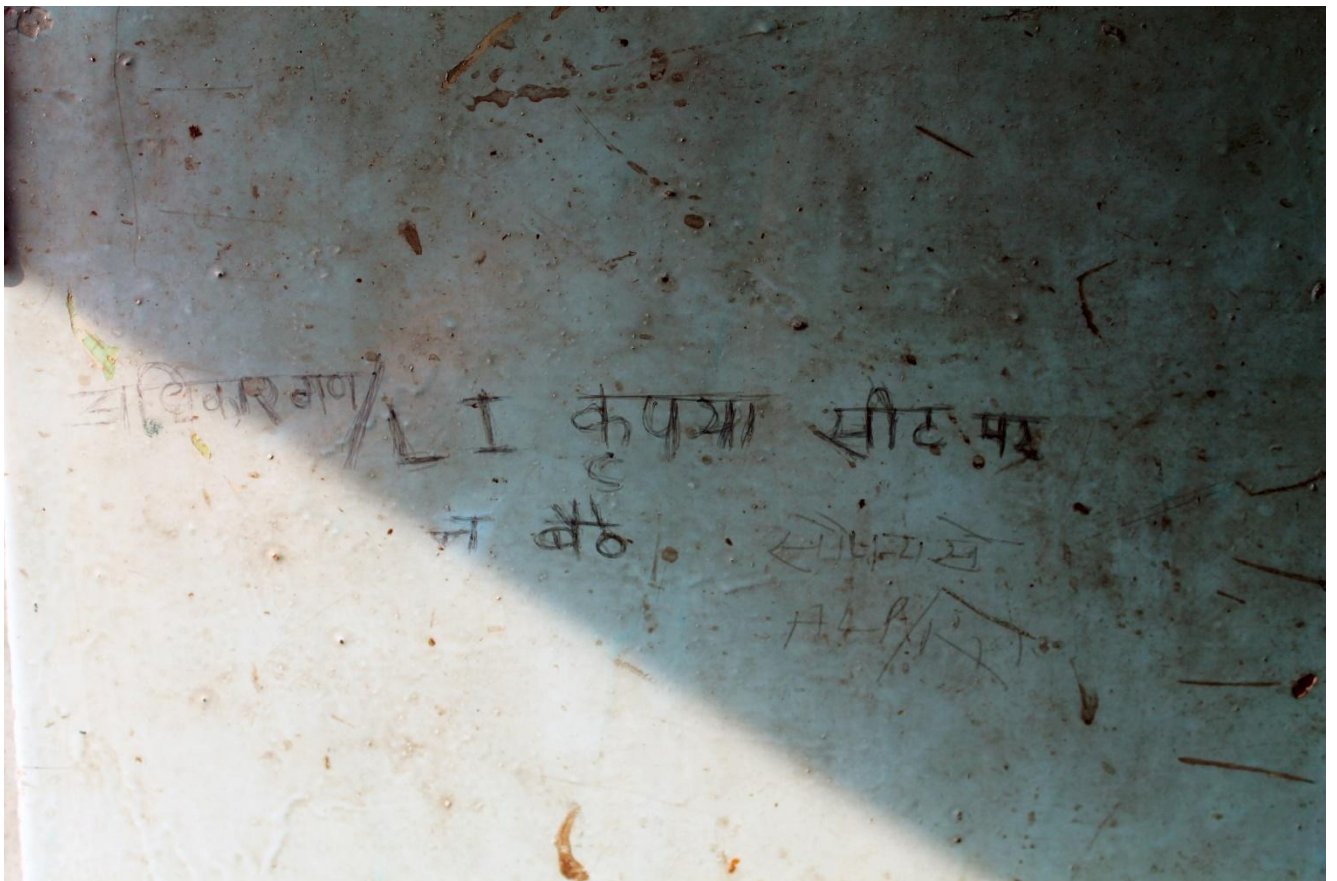
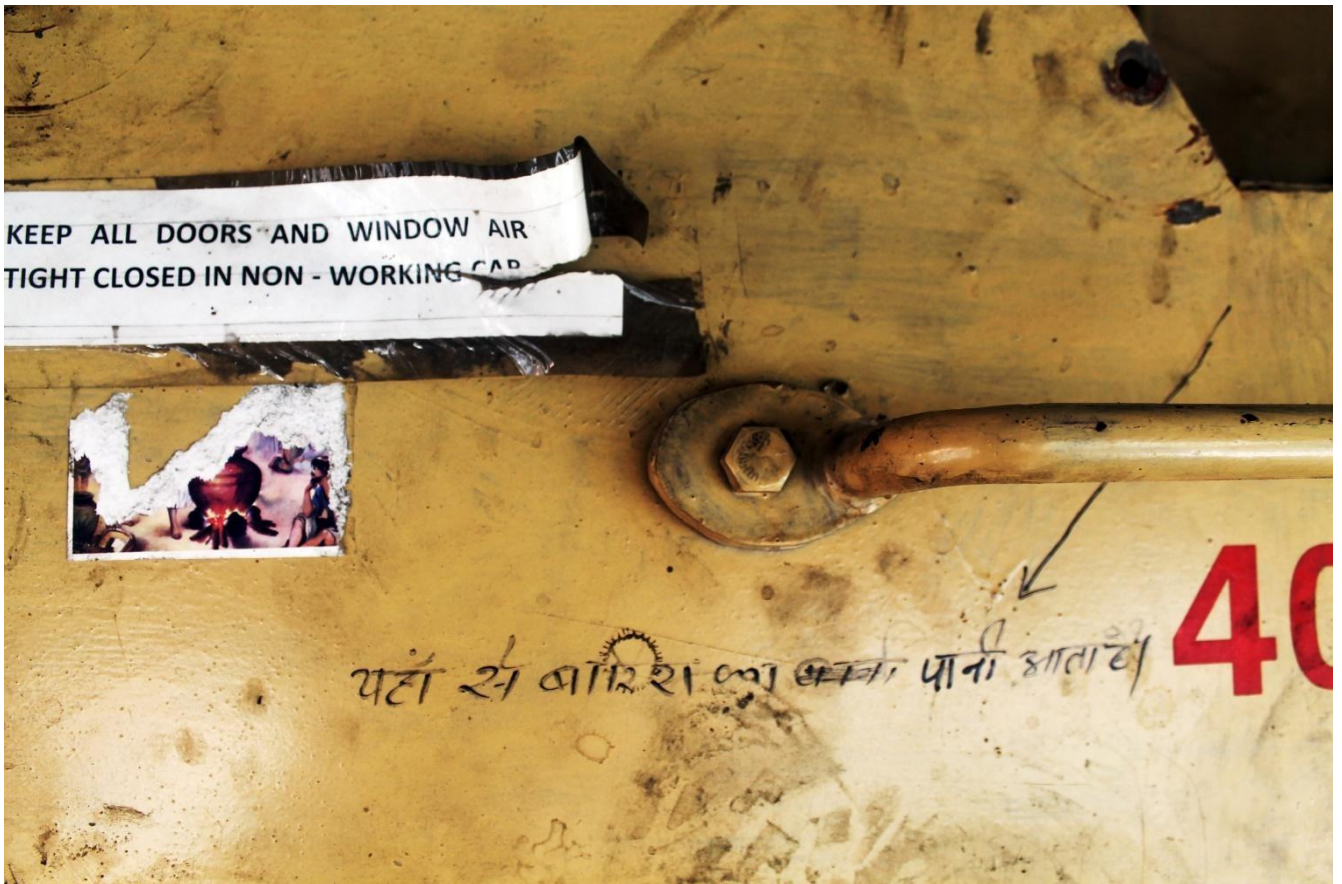
- Noise inside the engine becomes barrier in communication.
- The position of cabin light switch is out of reach, for which he has to stand and perform the operation every time.
- The position of the horn behind the seat affects the operation, i.e. he has to move backward every time he wishes to press horn.
- Problem watching the signal during day time, blind curves and during the night due to cabin light. Debate between Loco pilot and Asst. Loco Pilot.
- Not able to pass documents to Loco Pilot as the gap between them is far.
- Respond to passengers as in where the train will go.

■ Hardships of Loco Pilot

- Communication with Asst. Loco Pilot is a hardship.
- Visibility problem in looking at the signals.



4. Problems Faced while Driving





Unidentified openings



Emergency brake

Problems Identified through Research

These are the following issues raised from the present study:

- 1. Irregularities in lunch and dinner**
- 2. Irregularities in sleep**
- 3. Disturbed sleep**
- 4. Sleep disorder**
- 5. Work under pollution and high voltage electricity**
- 6. Due to heavy night duty feeling cold or rain or hot sun in summer when normal temperature up to 46 to 48 degree, in locomotive, temperature increases up to temperature 54 to 56 degree centigrade, i.e. adverse weather conditions.**
- 7. Noise level more than 100 db**
- 8. Insufficient facilities in running room**
- 9. Unhygienic water and meal atmosphere**
- 10. Suffer from stress related disease (hypertension, diabetes, frequent headaches etc.)**
- 11. No any calendar day rest provision, so that they may fulfil their family and social obligations.**

12. All their personal work has to be done by availing leave, or between short spells in between duties, which creates mental agony, losing concentration in running duties.

13. Do not spend sufficient time daily with his family members.

14. Always miss out quality time with his family and friends because of nature of work.

3. The Design Brief

To design the Loco Pilot control board considering the ergonomics, usability of the user along with the functionality of the cabin controls.

Various Controls associated with the Loco Pilot



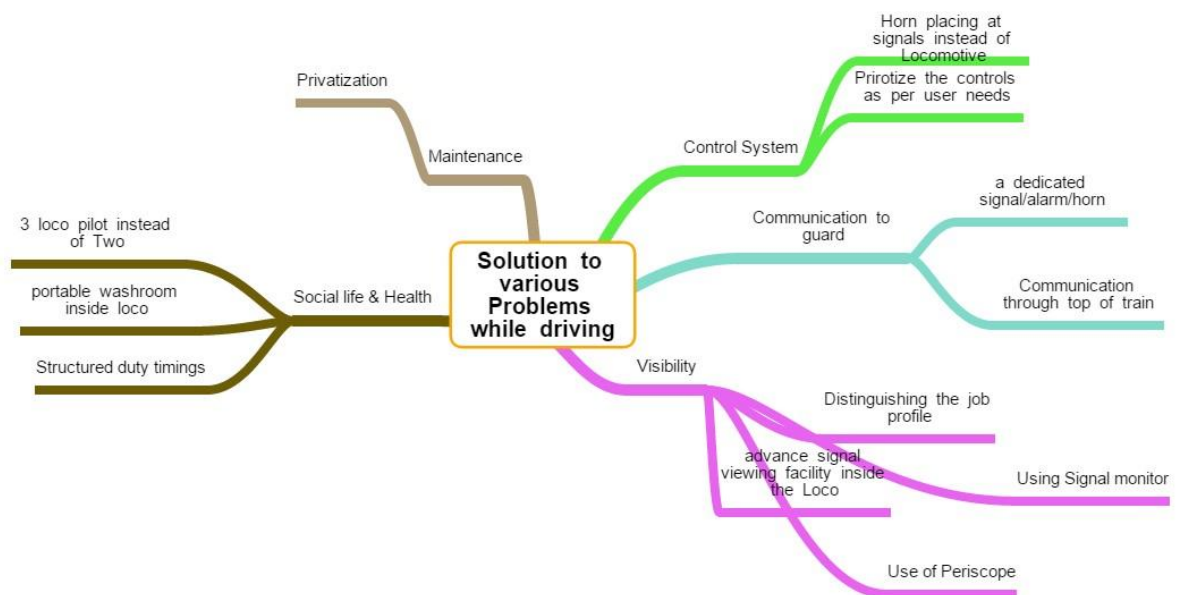
1. Problem Statement

The issue with the Indian government system is that rules are made wisely but aren't followed up to the mark. The same methodology implies here also, where in the process of engine maintenance, the control system of the Loco Pilot cabin changes every time the engine comes out of the maintenance shed.

Though the problem is not visible from the outside, it directly affects the mental health of Loco Pilots in the way it should not. It results in bad learn ability of controls and bad memo ability of controls among the Users. The end result is even more hilarious. When the user isn't able to concentrate on the task he is assigned to, the efficiency of the result decreases automatically. However, these causes might not play an important role in running the

engine, but they play a critically major role among the users who are performing the operation of running the engine.

2. Proposed Solutions



Prioritizing the Controls-User Centric Design Approach

The User Centric design approach focuses on user interaction at each and every stage of the design input. In this case, various users were given a list of controls which have more interactions with the users compared to the other ones.

The following is the result obtained after testing 10 different users for deciding the hierarchy of controls.

Engine fault detection

Horn Brakes Throttle Emergency Brakes
Head lamp Switch Speedometer Walkie Talkie
VCD button Flag/torch light Cabin light Switch
Circuit Breaker Sander Driver duty book

Loco Technical Specifications

Understanding the Job Profile

Commitment

Endurance

Responsibility

Patience

Continuation

Stoicism

Self Discipline

Persistence

Attention

Understanding the User

Loco Pilot

A matured man with less knowledge about everything other than his surroundings.

- Decrease in physical strength
- Decreased Hand eye co-ordination
- Slow reaction time
- Lung and Heart capacity decreases

Interaction with the Control Board



Assistant Loco Pilot

A young aspiring mind, ready to seek knowledge about everything that he observes around.

- Innovative thinking
- Enthusiastic living
- Learning and Growth

Interaction with the Control Board



Design Jargons for a Loco Pilot

Simplistic

Schematic

Aggregated

Minimalistic

Serious

Loyal

Universal

Far reaching

Holistic

Genuine

Devoted

Integrated

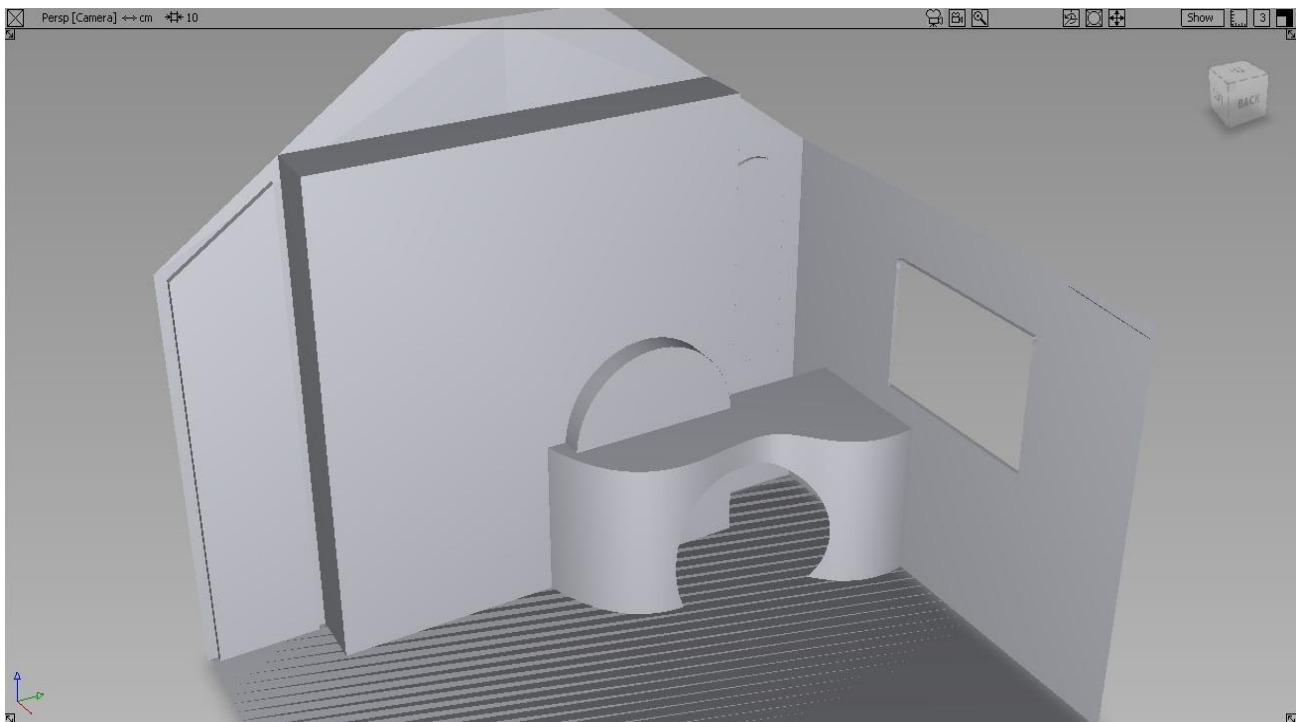
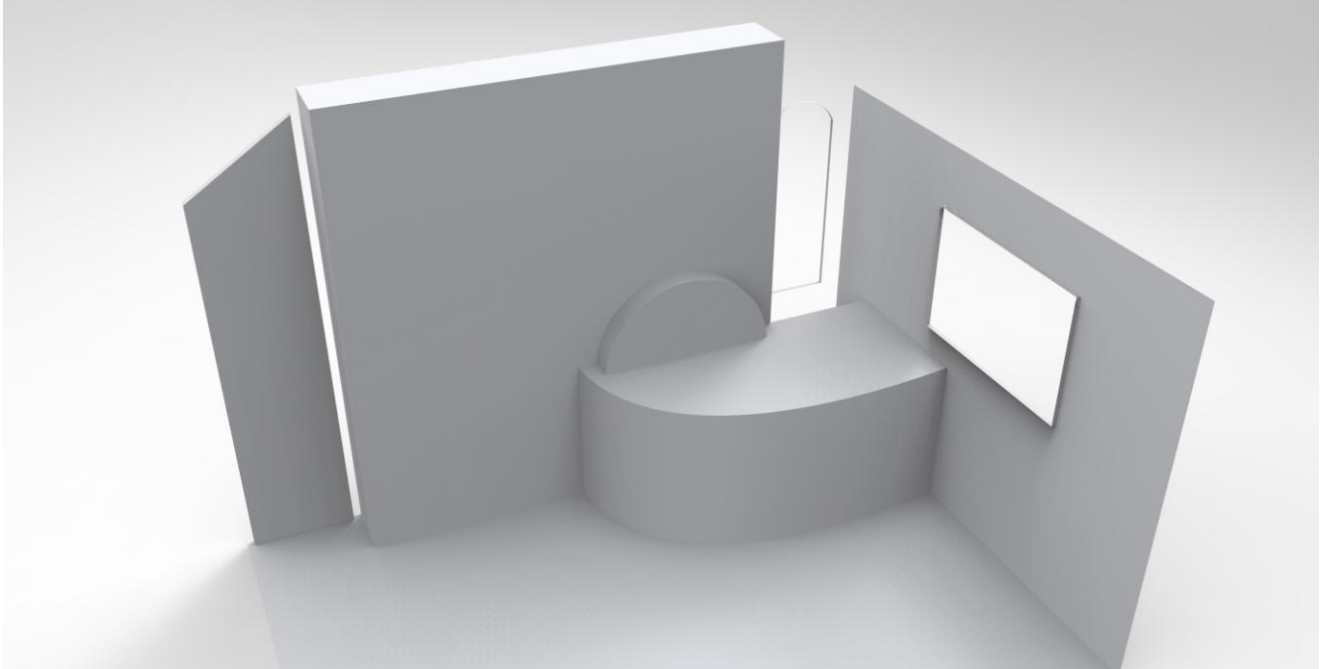
3. Mood Board



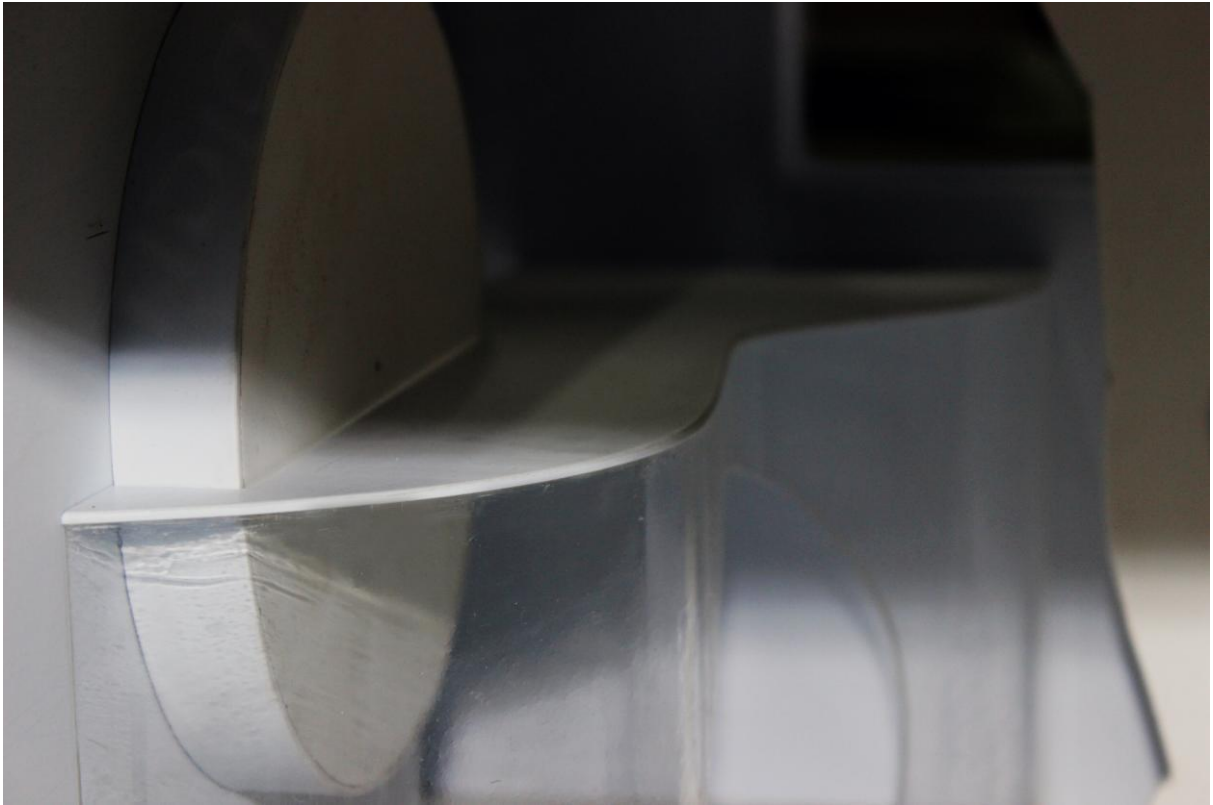
4. *Theme Board*



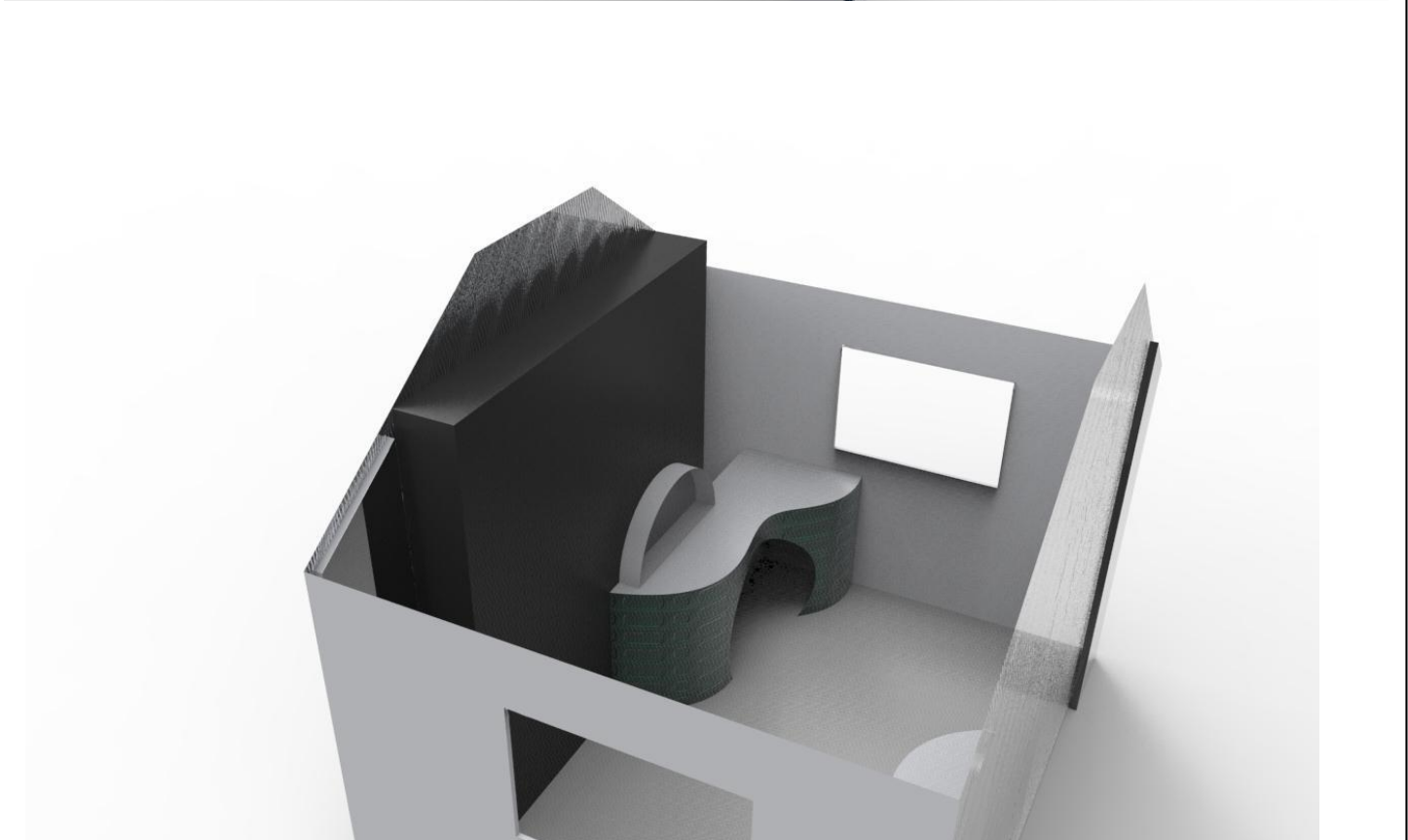
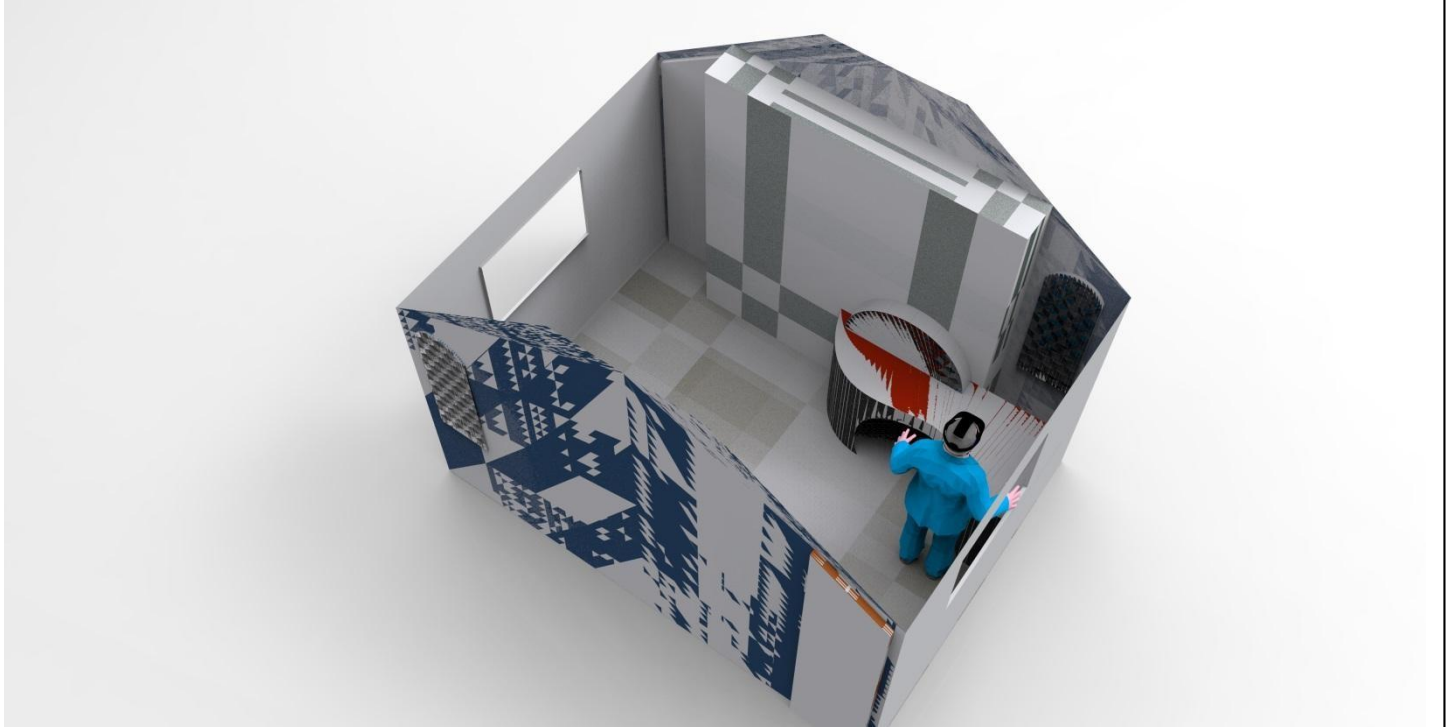
4. 3D CAD Models

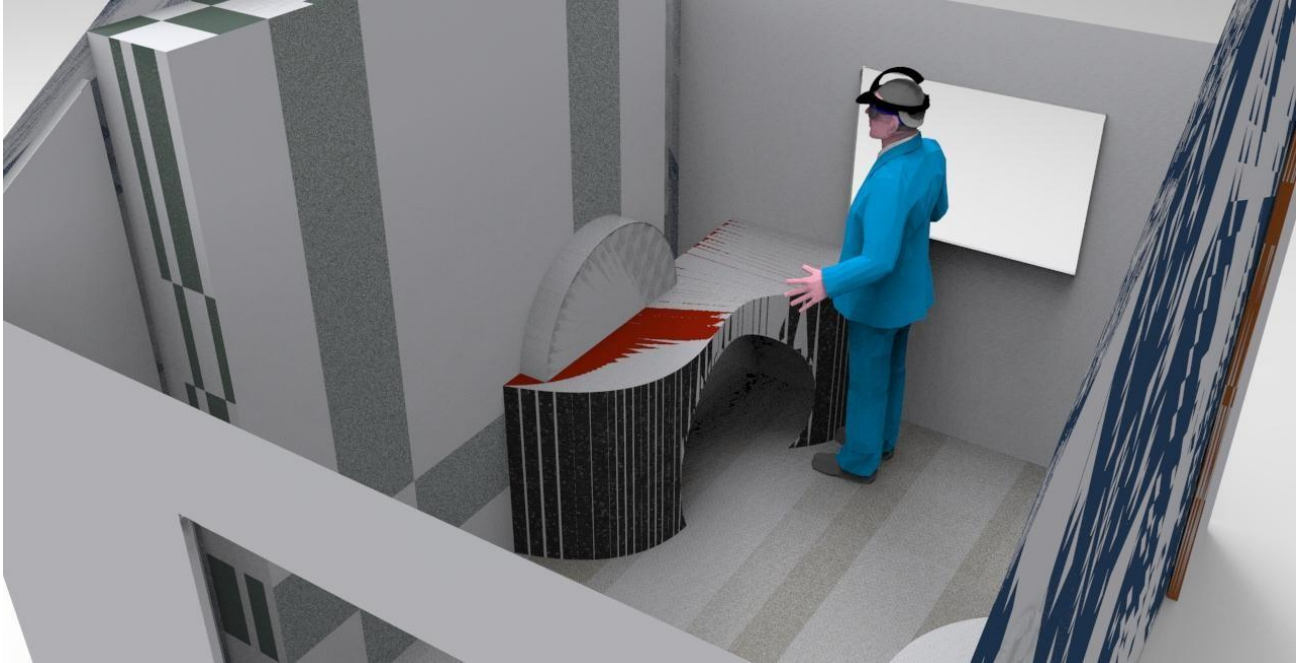


5. The Final Concept-Phelgm



1. *Concept Renderings*





6. Conclusion

There are flaws happening in each and every minute section of working of Indian Railways. There have been lots of system and supports made to rectify the processes but the corruption is playing a major role by providing the barrier in between.

Through this project, I came to know about the hardships of the Loco Pilot, which are hardly taken care of. The deep diving amidst the lives of Loco Pilot generated scope for the improvement

The result is in the form of Solution Guidelines for various problems faced. Along with that, the design of control board has been attempted on user's perspective.

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