Railway :Operational Procedure

MD. Miajahan

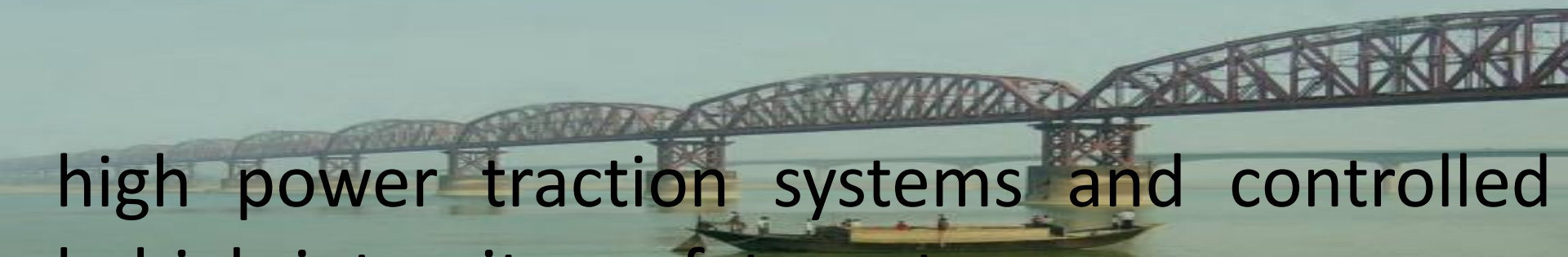
General Manager & Project Director

Bangladesh Railway Reform Project

Rail Bhaban, Dhaka.

What is a railway?

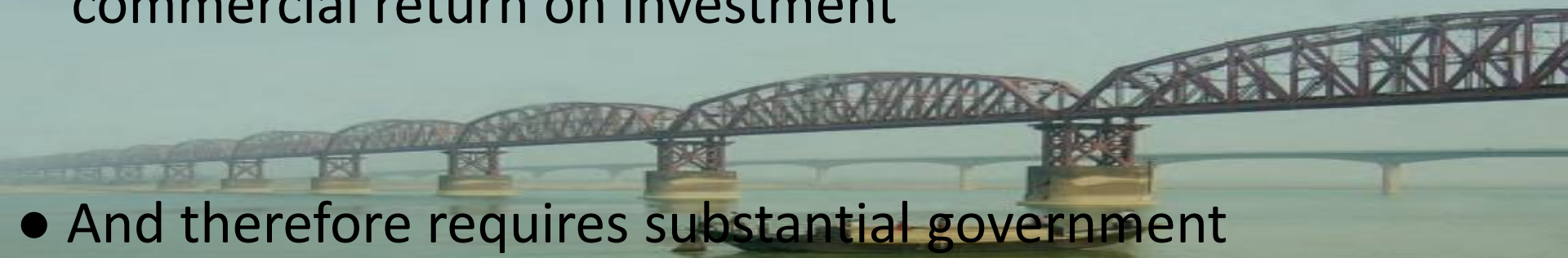
A railway may be defined as a high-value, fixed guidance land transport system carrying passengers and freight in purpose-built carriages using specifically designed,



high power traction systems and controlled byhigh-integrityy safety systems.

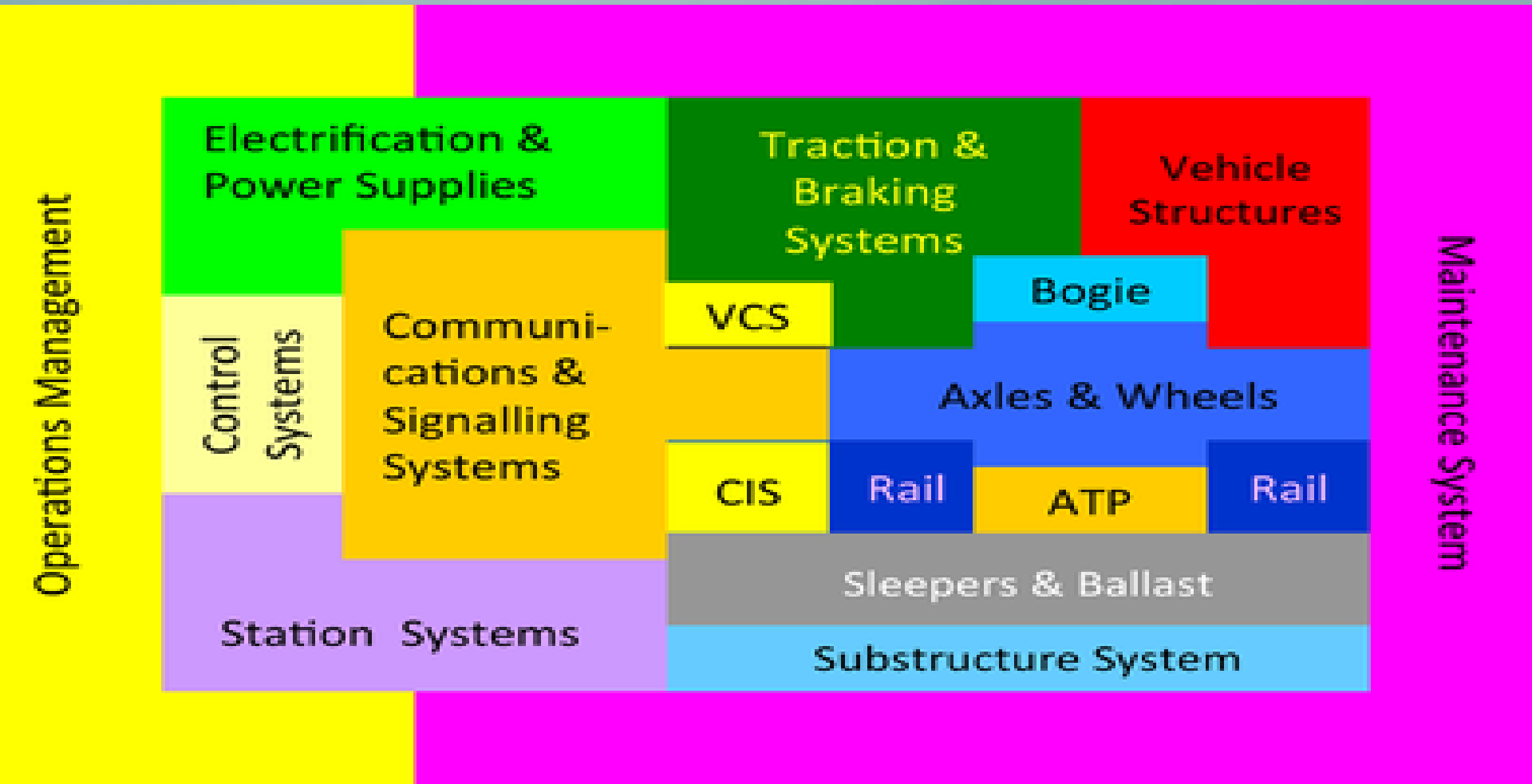
So Railways are subject to :

- Strictly regulated safety regimes,
- Reliable long distance communications
- Specially trained staff meeting all requirements,
- Sometimes working alone in hostile environments.
- Need to regular maintenance
- The costs of a railway do not normally offer a commercial return on investment



- And therefore requires substantial government subsidy, thus bringing with it a high degree of intrusive political interference and often malevolent media reporting.

A railway is a system. It comprises many parts that fit together to make the system work. If any of the parts fail to operate correctly, the system will quickly stop functioning, and the railway's customers, both freight and passengers, will see a deterioration in the service provided.



Train Operations

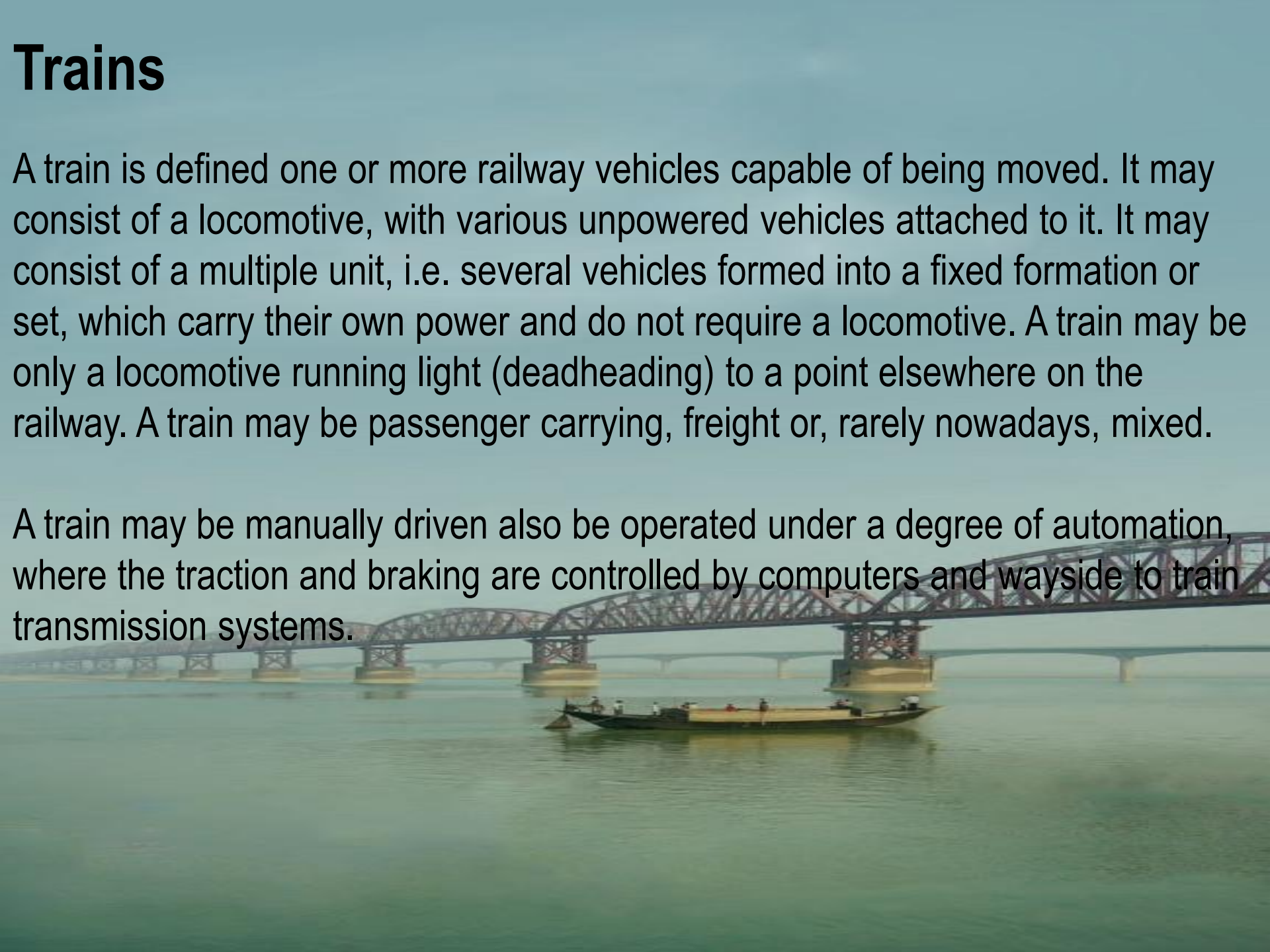
The Objective:
The infrastructure of a railway is its most expensive asset, and A train is an expensive piece of kit. To achieve commercial return on investment, maximization of the line of route is essential. Good trained operations management will play an important
role.

To achieve optimum targeted results, operations management needs to use the route, the rolling stock, and operating staff in the most effective way.

Trains

A train is defined one or more railway vehicles capable of being moved. It may consist of a locomotive, with various unpowered vehicles attached to it. It may consist of a multiple unit, i.e. several vehicles formed into a fixed formation or set, which carry their own power and do not require a locomotive. A train may be only a locomotive running light (deadheading) to a point elsewhere on the railway. A train may be passenger carrying, freight or, rarely nowadays, mixed.

A train may be manually driven also be operated under a degree of automation, where the traction and braking are controlled by computers and wayside to train transmission systems.



Fixed Guidance

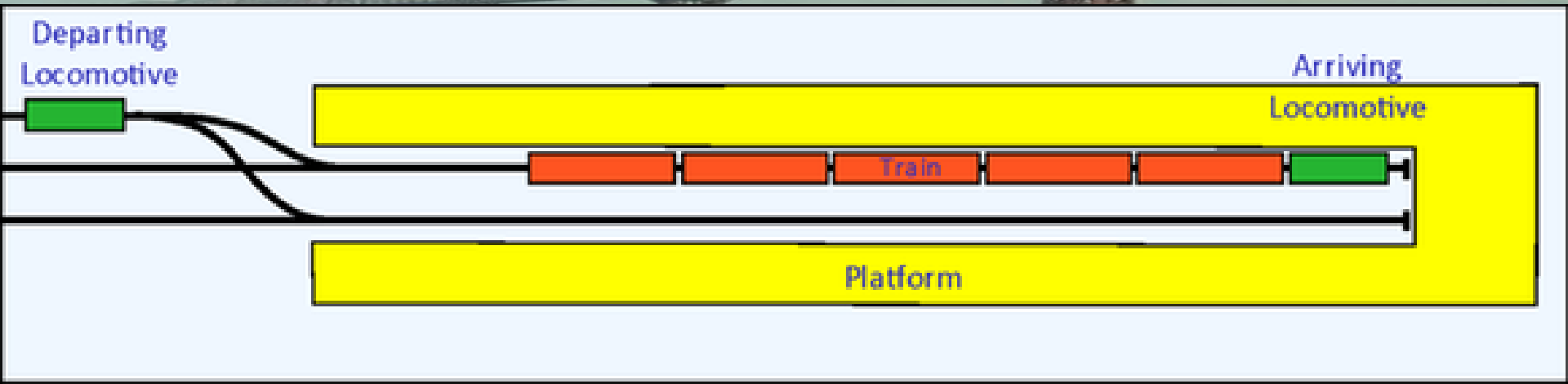
. A railway is a fixed guidance system. The guideway - the track - decides where the train will run by guiding the wheels, so there is no separate steering mechanism. The track guides the train’s route. The train’s wheels are designed to fit the rail, compensate for curves and allow them to be negotiated at a reasonable speed. There are other types of guidance systems, such as specialist rail designs for street railways and for rubber-tiredd metro trains.

The Wheel-Rail Interface

The contact between them is sitting on the rails without guidance except for the tire’s shape in relation to the rail head. Contrary to popular belief, the flanges should not touch the rails. Flanges are only a last resort to prevent the wheels becoming derailed - they're a safety feature. The wheel tire is coned, and the rail head is slightly curved. The rails are also set at an inward angle.

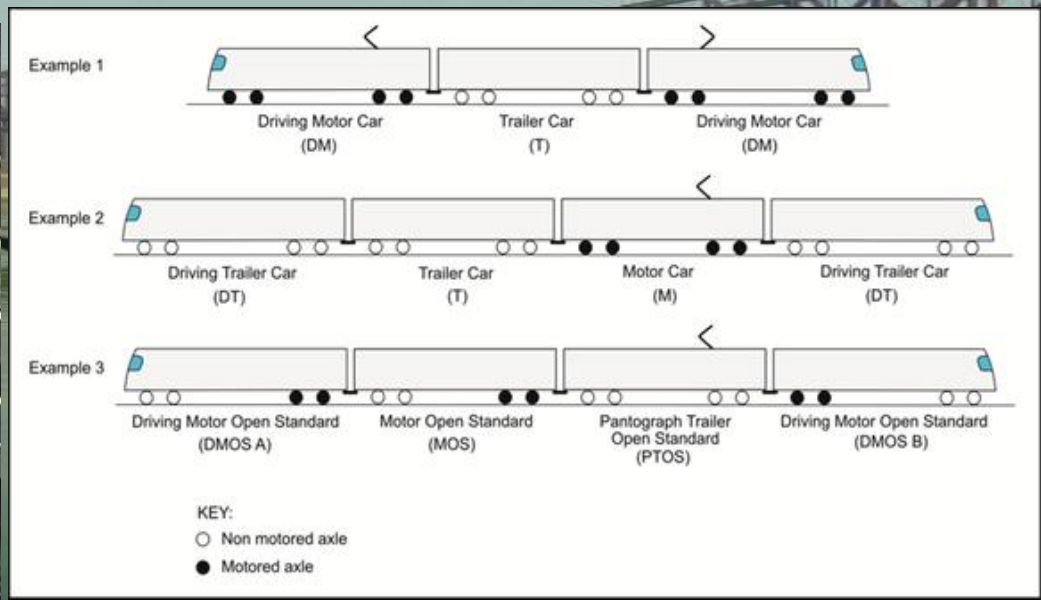
Terminal Operations

When a train arrives at a dead-end terminal, the locomotive is trapped between the train and the buffer stops. The only way to release the locomotive is to remove the train and for that, a second locomotive is required. This second loco is attached to the other end of the train and will be used to provide power for the return trip. . This problem can be solved a crossover to a run-around track is provided. This is sometime referred to as a "locomotive escape"



Multiple Unit Operation

Locomotive operation of intensive services was rapidly phased out when electric traction, using "multiple unit" operation, was introduced in the late 19th century The facility for the electric traction system allowed a number of small power units to be distributed underneath the floors of several vehicles in the train. They were all simultaneously controlled by the driver in the leading car through wires running the train length. Thus, the electric multiple unit, or EMU, was born. DMUs (diesel multiple units) were developed using the same principles in later years. Vehicles in multiple units are usually referred to as "cars" and are known as "motor cars“ and "trailer cars“.



Headway :

This is the name given to the elapsed time between trains passing a fixed point in the same direction over the same track. It is usually expressed in minutes or hours e.g. "trains were running at a 30-minute headway". Another way of expressing it is as trains per hour (TPH).
A well-run railway shows up at various times of the day and operates its trains accordingly. Trains can be run at even intervals or at a given "headway." This may be two hours for a long-distance, mainline route or five minutes for a metro.

The headway is used in calculating the number of trains required for a particular route.

Terminals, Loops and Turn backs

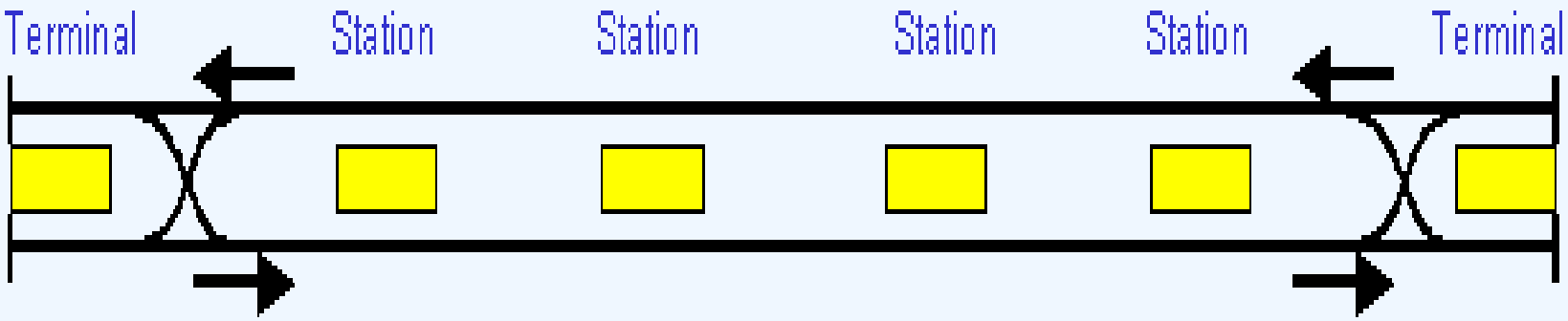


Diagram showing a simple end to end metro line with two platform terminals at each end

There are three ways of turning a train requiring to reverse its direction at the end of a trip. First a simple change of direction

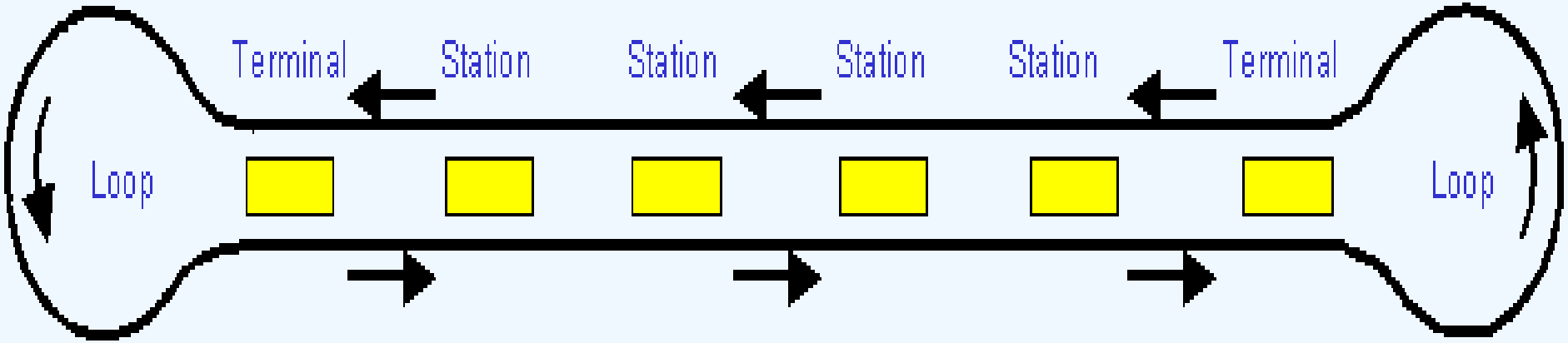


Diagram showing a simple metro line with terminal loops at each end

Second, you can drive the train around a loop track beyond the terminal station

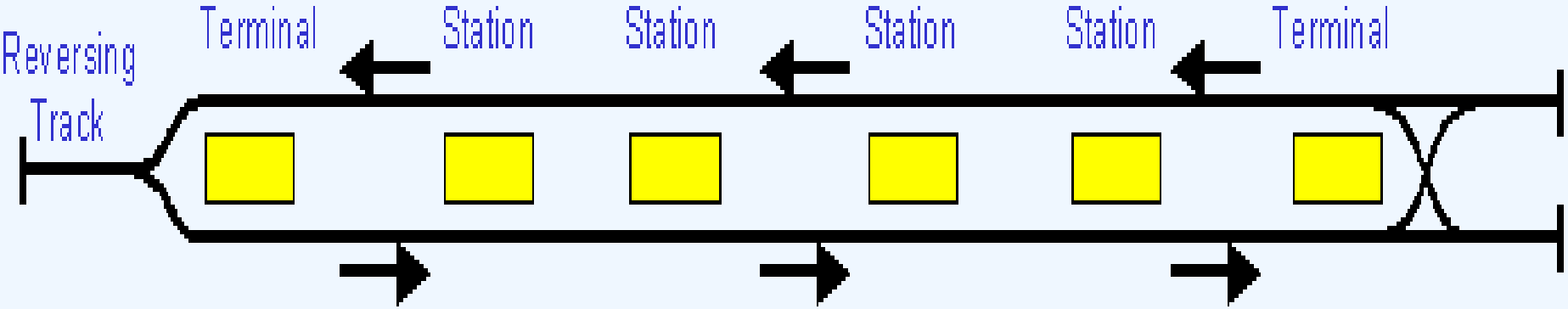


Diagram showing a simple metro line with a single reversing siding at one end. In the US this arrangement is referred to as a pinched loop. The other end has two reversing tracks beyond the terminus.

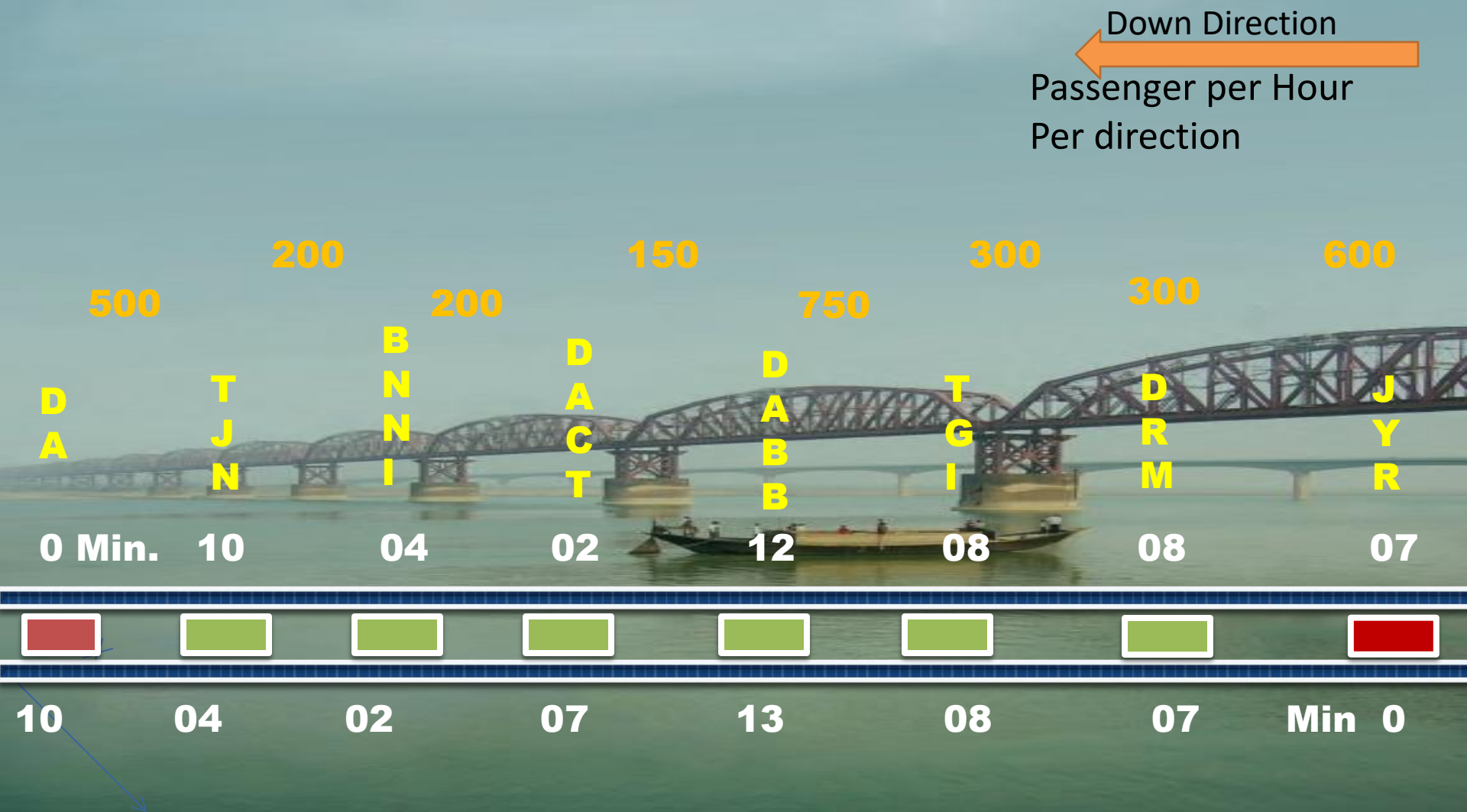
Finally, you can provide a reversing track (or turn back, as it is called in the US). The train deposits arriving passengers in one platform and goes forward to the siding where it changes direction and then proceeds into a departure platform.

The first option - a simple reversal procedure - is the most popular since it uses least space and is reasonably quick. For the second option, tram or light rail operators who equipped their trains with a cab at one end only favour the loop. Some metro operators also use it, notably Paris and New York.

The third option is a reversing or turn back track extended beyond the station

Train Service Planning :

How a train service is planned for the peak hour of a short Commuter line. Suppose we could call it the Dhaka To Joydebpur line. The diagram below shows the elements involved in planning the train service.



Tripe Time DA to JYR 51 Min.	Train capacity (crush Load)= 700
Trip Time JYR To DA 51 Min.	Load factor= 85% or 595 passengers
Turn round Time at DA 20 Min.	Maximum Load require=750 pas/hr.
Turn round Time at JYR 20 Min.	Train Required=3000/595= 5.04 or 5 per hour, therefore Headway= 12 min
Total round Trip time (Start from JYR to start from JYR)= 142 min	Number of Train required = Round Trip time (142 min`s)/Headway-12 min=11.83 or 12 trains.
= 2 hrs. 22 minutes	

First, you have to find out how many passengers will use the service.

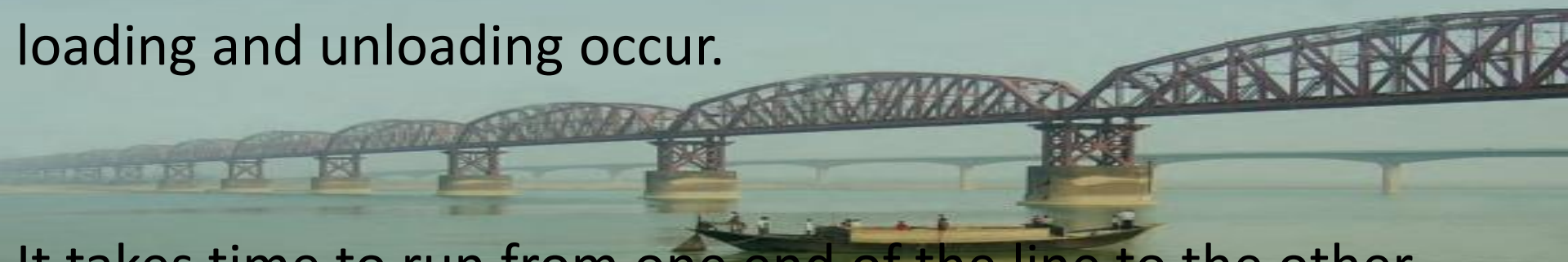
- Assessing the number of people in a given area who will come to the station during each hour of the day
- how they will get there.
- Some will walk,
- some will use a rail station, CNG or bus service
- And some will drive if there is cheap parking.

- For walkers, 500 to 800 meters is about the limit.
- The next stage is to determine where the people want to go and when

The train service has to be planned to carry the people who turn up. During the peak hours, this can be many people. Off-peak?

Accurate calculations are essential in determining the frequency and number of trains required to meet the demand. This precision is a key aspect of effective train service planning.

Each train must stand or "dwell" at each station while loading and unloading occur.



It takes time to run from one end of the line to the other, wait at the terminus, run back to the starting place, and wait for the next round trip departure time.

Train Loading

The next step is the train loading. First we determine the train capacity - in our example above, I have used a capacity of 700 passengers. This is a fairly small number for a modern metro line.

The density of passengers also determines the total capacity. In Western countries, the standing capacity of a train will often be calculated at 4 or 5 passengers per sq./m. In the Asian context, this number rises to 8 per sq./m. The standing area is the free floor area of the car, i.e. where there are no seats.

We also decide on a load factor. No train will fill with passengers equally from end to end and passengers will not arrive at stations in steadily flowing numbers throughout each hour. So, a load factor is applied.

. You divide the numbers of passengers travelling along the busiest section of line (11,500) by the train capacity (595) to get trains per hour (19.32). We have to call it 20 trains per hour as we can't run 0.32 of a train. Twenty trains per hour is equivalent to a train every three minutes or a 3-minute headway.

Rolling Stock Calculations

We are now ready to calculate the rolling stock requirements. To find out how many trains are required to operate a regular interval passenger service, the simple formula is applied:

Round trip time is divided by the headway.

The round-trip time is 39 minutes, and the headway is 3 minutes, so we need 11 trains to operate this service during the hour when 11,500 passengers are traveling over the busiest section of the line.

Post-peak hours, the number of passengers typically decreases, allowing for a reduction in the train service to match the demand. This flexibility in service means that for a metro line, the number of trains required can often be reduced by about 40% or even 50%. The planned train loading is usually adjusted during off-peak hours, resulting in a load factor of 50% or less, showcasing the dynamic nature of public transportation.

Rolling Stock Operation

The stock required to operate a regular passenger service will be calculated based on working paths, and each train will be designed. These will take into account:

* The location of the depot
* The location of other stabling points
* The frequency of exterior washing required
* The frequency of maintenance inspections
* Other routes where the trains can be used

A train must be given time to move from its stabling point to the first station, where it is required to pick up passengers. Time will also be allowed for its return to a stabling position; weekday metro or commuter service present complicated patterns of use which look like this:

All day use: AM start to night finish

Peak only: AM start to AM finish; PM start to PM finish

Peak and evening: AM start to AM finish; PM start to Night finish. Mid-day: AM Start to PM finish

Stock Balance

Rolling stock must be "balanced" at the end of the traffic day, and timetables must be designed to allow this. "Balanced" means that any place where trains start from (a depot or sidings) must have an equal number of trains restored to that location at the end of the day.

Another point to realize is that it will be necessary to ensure that all trains return to the depot within 2 or 3 days, so

It's crucial that all trains return to the depot within 2 or 3 days for maintenance. This balancing act, therefore, ensures that the trains rotate through the depot in this 2-3 day period. Your role in performing this balancing act is significant and is made easy by the use of a technique known as diagramming.

Time keeping/Punctuality

In any business, the customer expects to get, at the very least, what he is told he will get. If he is told his train will arrive at 8:30 and it arrives at 10:00, he will also get upset. Timekeeping is number one priority.

Any train which arrives within 90 minutes of its timetabled time. This is not a good customer relations exercise, nor good railway practice and not

acceptable by the passengers . So you try to operate trains like away there is no time deviation .

Recovery Time

In order to "improve" timekeeping, railways have always provided recovery time in timetables. This is extra time, above that usually required for a train to complete its trip on time, allocated in case of a small delay or temporary speed restriction. Recovery time should be strictly limited and eliminated altogether when possible. It should not be used as an excuse for bad timekeeping.

Freight Operation :

In the history and development of railways, freight traffic was originally more important financially than passenger traffic. Railways are ideal for the movement of bulk traffic over long distances and many rail routes were built solely for freight traffic or for moving mined ore from mine to port. The long distances of the larger countries like Canada, the United States, South Africa and Australia make the effectiveness of the rail mode come into its own and some railways operate very long heavy trains with a number of locomotives to provide power.

Train Maintenance

Railways are made up of complex mechanical and electrical systems, and there are hundreds of thousands of moving parts. If a railway service is to be reliable and safe, the equipment must be kept in good working order, and regular maintenance is the essential ingredient to achieve this. A railway will not survive for long as a viable operation if it is allowed to deteriorate and become unsafe because

of lack of maintenance. Although maintenance is expensive, replacing the failing equipment early in its life will become more expensive because maintenance has been neglected.

Maintenance Facilities

Trains require special facilities for storage and maintenance. The basic design of these facilities as changed little in the last 100 or more years and, in many cases, the original sites and buildings are still in daily use. The layout of a maintenance facility or depot will consist of a storage yard, a car cleaning area, an inspection and light maintenance shed, a heavy maintenance shop and, possibly, a separate locomotive shop or at least an area for locomotives if EMUs are the main service providers

Pahartali Carriage and Wagon Workshop 1947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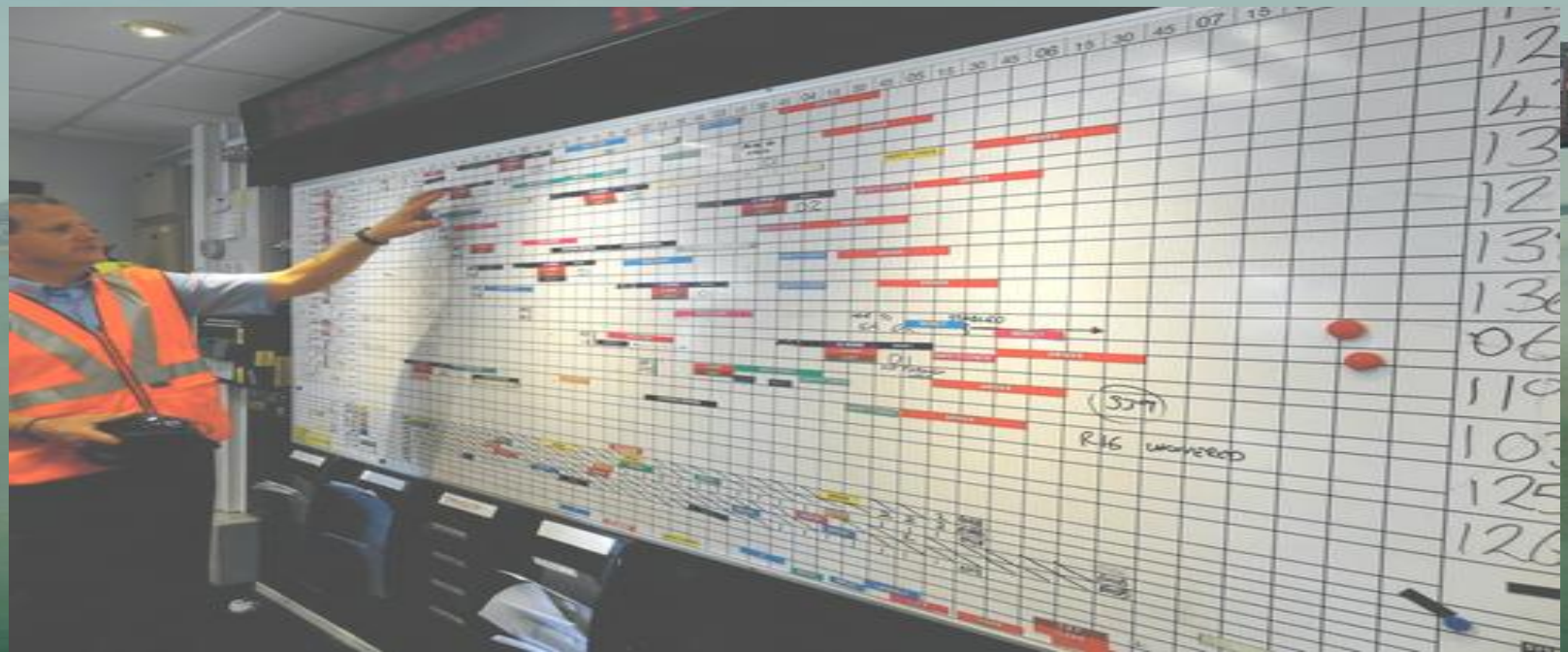
Inspection Sheds

Special facilities are required to carry out rolling stock inspections (Figure 6). A properly constructed building, capable of accommodating a whole train, should be provided. Access to the underneath of the train is essential and this must be designed to allow reasonable working conditions and safety. There are various ways of doing this. The most common used to be a pit provided between the rails of the maintenance tracks and, sometimes, pits on either side of the track as well, to allow access to the sides of the under frame equipment. A more common approach today is the "swimming pool" design, where the floor of the shed is sunk and the tracks are mounted on posts.

Maintenance Programs

Rolling stock maintenance can be programmed in one of three ways: by mileage, by time or by conditioning monitoring. Of these three methods, condition monitoring is the most recent. Traditionally, maintenance was carried out on a time basis, usually related to safety items like braking and wheel condition. Many administrations later adopted a mileage-based maintenance system



Failures :

As already mentioned, reliability is the key to running a successful railway. If the equipment, especially the rolling stock, is unreliable, the railway is not workable. A good railway management will keep track of its performance and its failures and, by this means, ensure that problems are eliminated before they become endemic.

Prediction

Every Railway management examined the risks of failures occurring in rolling stock by using a failure mode, effects and criticality analysis (FMECA) approach. The most critical failure modes in the system with respect to both reliability and economic criteria need to reviewed, the levels of failure criticality determined and provided possible methods for mitigation. “ **There was no wrong without a remedy,"**