

Automobile Engineering

Unit 1



Components of Automobile

The main units of an automobile are:

1. The Basic Structure
 2. The Power Plant
 3. The Transmission System
 4. The Auxiliaries
 5. The Controls
 6. The Superstructure
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The Basic Structure

1. The Frame
2. The Suspension System
3. Axles
4. Wheels
5. Tyres



FRAME

It is a rigid structure that forms a skeleton to hold all the major units together. The engine is mounted in front of the frame and is connected to clutch and transmission to form a compact power assembly.

There are two distinct forms of construction in common use:

1. The conventional pressed steel frame to which all the mechanical units are attached and on which the body is superimposed
2. The integral or frameless construction, in which the body structure is so designed as to combine the functions of body and frame.



Advantages of frameless construction over conventional framed construction.

- 1) Reduced weight and consequent saving in fuel consumption.
- 2) Lower manufacturing cost.
- 3) Compared to framed construction lower body position may be obtained, thus resulting in increased stability of automobile.



Disadvantages of frameless construction over conventional framed construction.

1. Reduction of strength and durability.
2. Economical only if frameless construction is adopted in mass production.
3. Increased cost of repairs in case of damage to body during accidents.
4. Topless cars are difficult to design with frameless construction.



Suspension system

The object of Suspension System are:

1. To prevent the road shocks from being transmitted to the vehicle components
2. To safeguard the occupants from road shocks.
3. To preserve the stability of the vehicle in pitching or rolling , while in motion.



Two distinct types of suspension system :

1. The conventional system , in which the road springs are attached to a rigid beam axle.
2. The independent system , in which there is no rigid axle beam and each wheel is free to move vertically without any reaction on the other wheel .



Axles

The weight carrying portion of axles , may be considered as beam supported at the ends, loaded at two intermediate points and subject to the following loads:

1. The vertical load at the spring centers due to the weight of the vehicle.
2. A force and load at the wheel centre due to driving or braking effort.
3. The torque reaction due to drive or brakes
4. The side thrust at the radius of the tyre due to centrifugal force when rounding a curve.



The Power plant

1. The Power plant (Engine) provides the motive power for all the various functions.
2. The power plant generally consist of an IC Engine- may be Spark Ignition or Compression Ignition type.

Transmission System

Various components of transmission system:

- Clutch
- Gear box(Transmission)
- A propeller shaft
- Differential

The Auxiliaries

The principle one , that is common to all type of vehicles:

The electrical equipment

- 1) Supply system – Battery and dynamo
- 2) The starter
- 3) The ignition system- battery and magneto ignition
- 4) Ancillary devices-
 - ✓ Driving lights- head lights, side-lights , tail lights , number plate illumination.
 - ✓ Signaling- horn , direction indicators and brake light.
 - ✓ Other lights-interior roof lights, panel light and reverse light
 - ✓ Miscellaneous- radio , heater , fans, electrical fuel pump, electric windscreen wipers.

Classification of Automobiles

Automobiles can be classified from the point of view of various considerations as follows:

1) Use

- i. Auto cycles
- ii. Motor cycles , scooters
- iii. Cars , jeeps
- iv. Buses and trucks

2) Capacity

- I. Heavy transport vehicles(H.T.V) ex trucks and buses.
- II. Light transport vehicles like car , jeeps etc

3) Make and Model

- i. Bajaj , Royal Enfield , Honda etc
- ii. Premier Padmini , Hindustan Ambassador , Maruti 800 etc
- iii. Tata , Leyland, Ford, General Motors , Nissan etc



4) Fuel used:

- i. Petrol vehicles e.g. scooters , motor cycles , cars.
- ii. Diesel vehicles e.g. buses , trucks , cars.

5) Body Style:

- i. Closed cars
- ii. Open cars like Sports car , convertible car.
- iii. Special styles such as estate car, station wagon etc.

6) Wheels:

- i. Two wheelers ex. Scooters, motor cycles , mopeds.
- ii. Three wheelers like autorikshaws , tempos
- iii. Four Wheelers e.g. cars , jeeps.
- iv. Six Wheelers e.g. trucks, buses.



8) **Transmission:**

- I. Conventional in which ordinary crash type gear box is used
- II. Semi-automatic having a two pedal transmission using manual operation of standard gear box, with automatic clutch control.
- III. Fully –automatic: employs transmission that uses combinations of epicyclic gear trains and torque converters



7) Drive:

- I. Whether the vehicle cab be driven sitting towards right or left side.
 - A. Left hand drive ex. American Vehicles
 - B. Right hand ex. Indian Vehicles
- II. Whether the front axle , rear axle or both axles are driving axles.
 - ii. Front wheel drive :ex Volkswagen car , Maruti car
 - iii. Rear wheel drive: ex Premier , Ambassador cars.
 - iv. All wheel drive : Jeeps

Car Body styles

1) Closed cars:

- a) **Saloon**- Has two or four doors , a single compartment with two rows of seats , one at the front and other at the rear. There is separate luggage space at the rear or at the front end.
- Hatchback**- A saloon with a door at the back is called hatchback.
- a) **Coupe**- In this type there is one row of seats for two persons. Only two doors are provided.
- b) **Limousine**- Driving compartment is separated from rear compartment by sliding glass division.

Saloon car



Hatchback



Coupe



Limousine





2) Open cars:

- a) **Sports-** Has two doors or less , is provided with a collapsible hood, a fold-flat windscreen and removable side - screens
- b) **Convertible-** The roof in this is of soft folding type and windows of special wind- up design. With these provisions the car may be either open or closed.



3) Special styles:

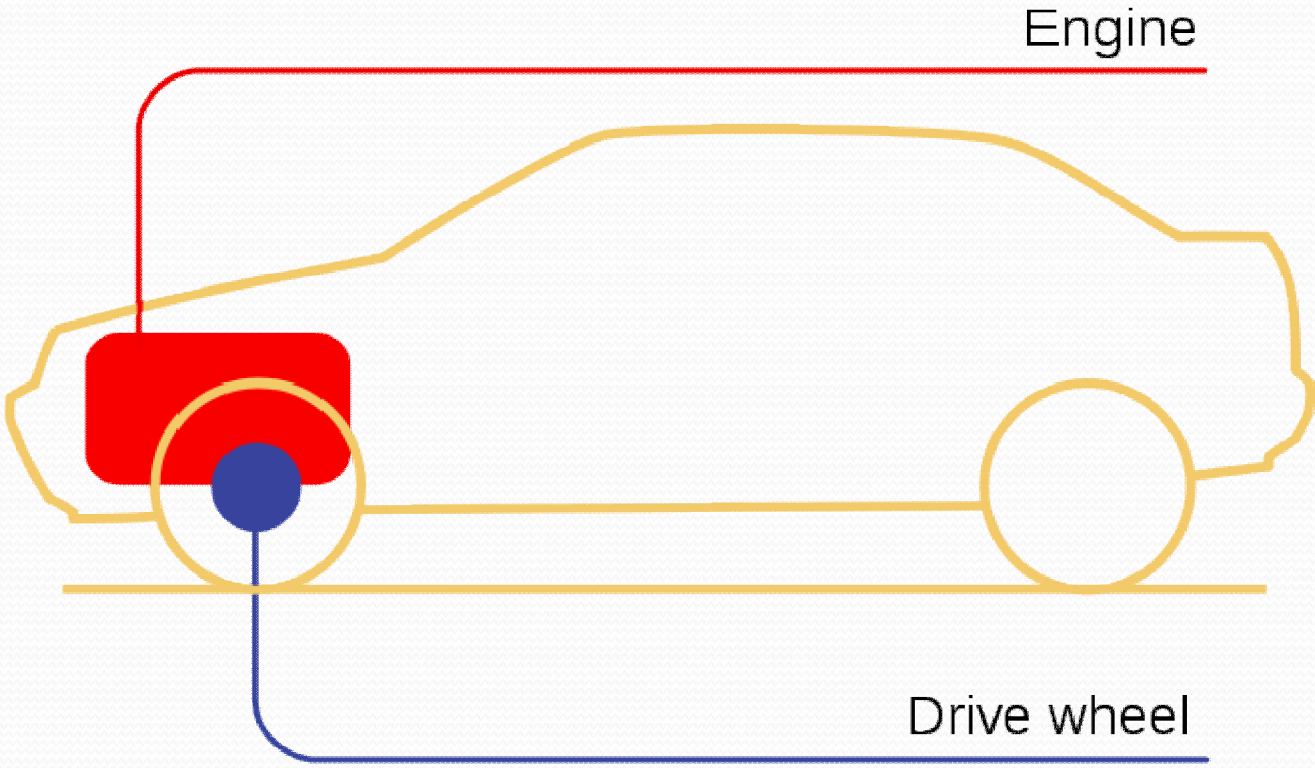
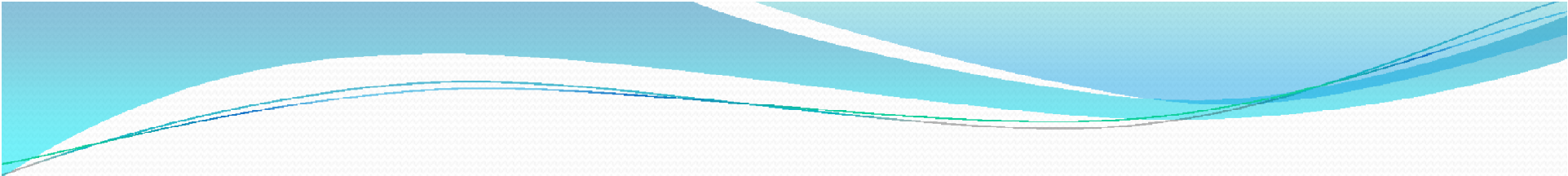
- a) **Estate Car-** A saloon with the passenger roof extended right up to the rear end. Rear door for loading with rear seats usually collapsible.

- a) **Station Wagon-** Wood panelled body in earlier days now only with a resembling look over the steel structure. Rear doors and seats for four or five persons.



Front engine Front drive(FF)

Front-wheel drive (or FF layout) is a form of engine/transmission layout used in motor vehicles, where the engine drives the front wheels only



Engine

Drive wheel





Advantages of Front engine front wheel drive:

1. Low chassis weight Since it is near to engine , it eliminates the propeller shaft and simplifying linkage for actuation of clutch and transmission.
2. Engine pulls the car rather then pushing it , avoiding skidding tendency, thus providing safety especially on snow covered roads.
3. Better road adhesion is obtained because larger part of the weight of automobile is taken on the driving wheels.



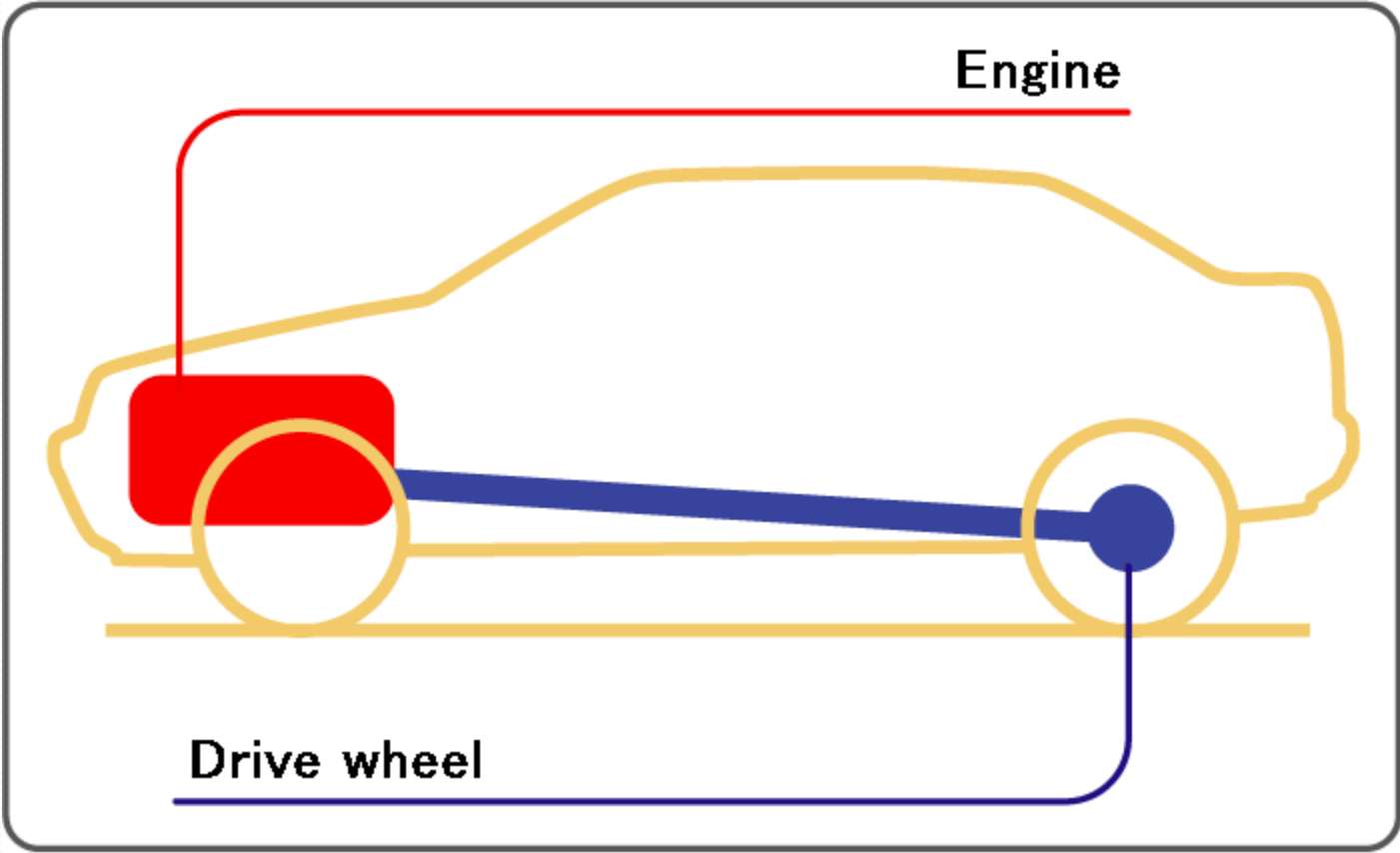
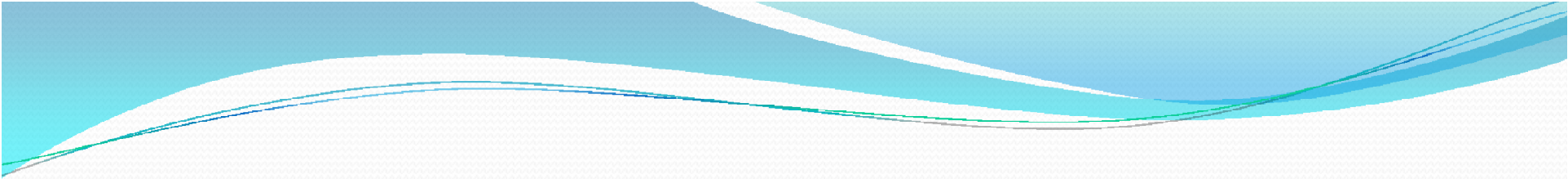
Disadvantage:

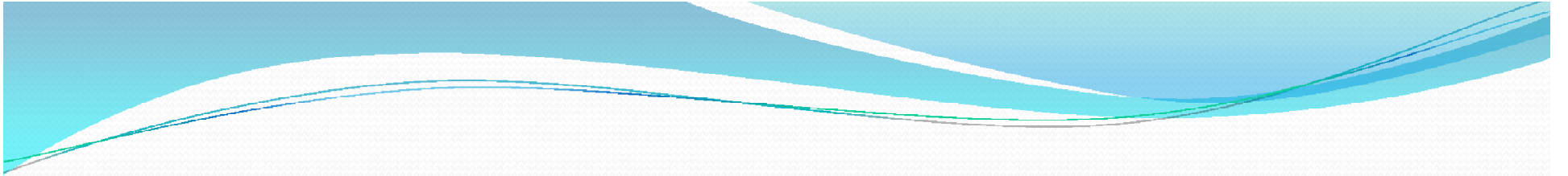
1. Front wheels which are in case driving wheels have to be steered also, which makes **the whole arrangement complicated**.
2. Two constant velocity joints have to be used in this case, because ordinary universal joints would give large speed fluctuation.
3. When going up steep gradients, the component of automobile weight on driving wheel is reduced, this results in decrease of tractive effort.
4. Increased concentration of weight at the front tends to make steering slightly heavier.



Front engine rear drive (FR)

- It places the engine in the front of the vehicle and the driven wheels are located at the rear
- The vast majority of rear wheel drive vehicles use a engine in the front of the vehicle, driving the rear wheels via a propeller shaft linked via a differential between the rear axles







Advantages of FR

- FR layout is often chosen for its simple design and good handling characteristics
- Even weight distribution
- During heavy acceleration, weight is placed on the rear, or driving wheels, which improves traction
- Better Serviceability
- Robustness — due to geometry and packaging constraints, the universal joints attached to the wheel hub have a tendency to wear out much later than the CV Joints typically used in front-wheel drive counterparts



Disadvantages of FR

- Increased weight — The components of a rear wheel drive vehicle's power train are less complex, but they are larger
- Higher initial purchase price



- Advantage of **rear engine with rear wheel drive**:

1. When going up steep gradients, Increase of tractive effort
2. Front axle construction is simplified which is used for steering only
3. Absence of propeller shaft allows to decrease the chassis weight
4. Noise and heat are carried away from the passengers and front of the vehicle can be designed for better visibility because of absence of engine.
5. Silencer system and exhaust pipe need not span the entire length of vehicle and can be compact.



Disadvantages :

1. Increased weight of vehicle at the rear causes the vehicle to become unstable at high speeds.
2. Cooling efficiency is reduced .
3. Dangerous at the time of collision as petrol tank is placed in front



SAFETY features in a car

- Seat Belts
- All-Wheel Drive
- Air Bags
- Anti-lock Brake Systems
- Electronic Stability Control
- Head Injury Protection
- Traction Control
- Head Restraints



- **Seat Belts**

In the event of a crash, seat belts are designed to keep you inside the vehicle. They also reduce the risk that you will collide with the steering wheel, dashboard, or windshield.

- **All-Wheel Drive**

All-wheel drive distributes power to both front and rear wheels to maximize traction. Unless combined with traction control, all-wheel drive systems do not prevent the drive wheels from slipping when you apply excess power during acceleration



- **Air Bags**

Depending on the speed at impact and the stiffness of the object struck, front air bags inflate to prevent occupants from hitting the dashboard, steering wheel, and windshield. Side air bags reduce the risk that occupants will hit the door or objects that crash through it.

- **Antilock Brake System**

An antilock brake system (ABS) prevents a vehicle's wheels from locking during "panic" braking, which allows the driver to maintain greater steering control -- a key factor in avoiding a collision.



- **Electronic Stability Control**

Electronic stability control is designed to assist drivers in maintaining control of their vehicles during extreme steering maneuvers. Electronic stability control senses when a vehicle is starting to spin out (oversteer) or plow out (understeer), and it automatically applies the brake to a single wheel.

- **Head Restraints**

Head restraints are extensions of the vehicle's seats that limit head movement during a rear-impact crash, thus, reducing the probability of neck injury. Head restraints meeting specific size and strength requirements are required in front seats, but not in rear seats.



- **Traction Control**

Traction control systems improve vehicle stability by controlling the amount the drive wheels can slip when you apply excess power. The system automatically adjusts the engine power output and, in some systems, applies braking force to selected wheels during acceleration. Traction control is mainly found in vehicles with four-wheel antilock brake systems.



The Chassis Construction

The chassis of automobile consists of following components suitably mounted:

- 1) Engine and the radiator
- 2) Transmission system
- 3) Suspension system
- 4) Road wheels
- 5) Steering system
- 6) Brakes
- 7) Fuel tank



Classification of chassis

1. **Conventional control chassis:** - Engine is mounted in front of the driver's cabin
2. **Semi-forward control chassis:-** Half of the engine is in driver's cabin whereas the other half is front, outside the drivers cabin.
3. **Full forward control chassis:-**Engine is mounted completely inside the drivers cabin(Maximum utilization of space)



Frame

Frame is the basic unit to which various components are attached and body is bolted onto the frame later on.

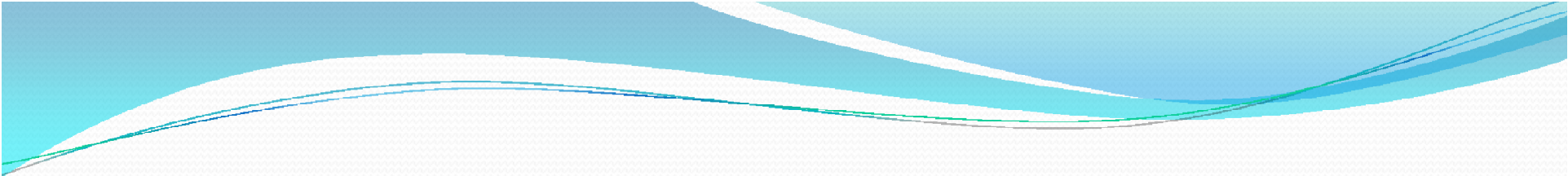
Functions of the Frame:

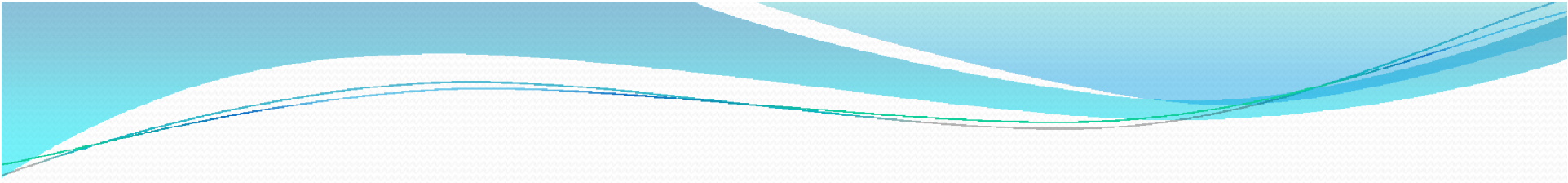
- To support the chassis components and the body.
- To withstand static and dynamic loads without undue deflection or distortion.

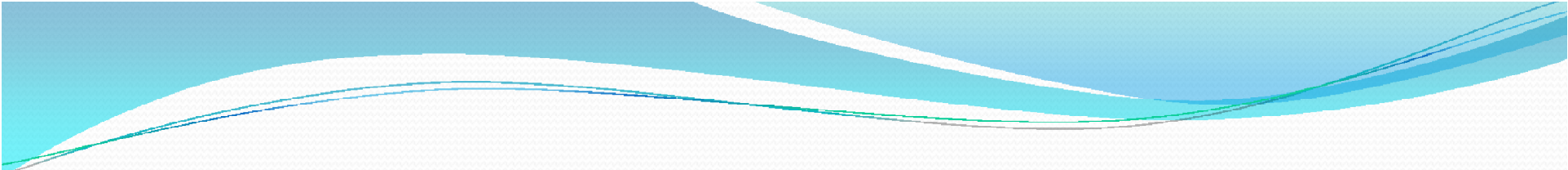


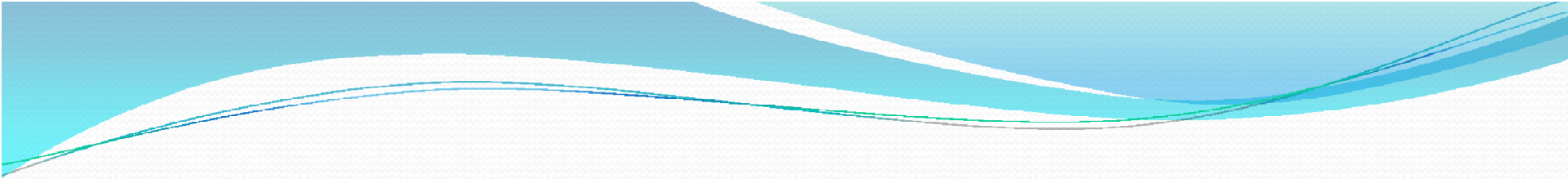
Automobile Production - Future Trends

- Though the present day automobiles have travelled a long distance since the first motorized vehicle appeared on the road about a hundred years ago, After about a century, basic changes are taking place in the very concept of the automobile and its system of production.
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- Some of the special characteristics of automobile production in the future will be:

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- **Automobile Features:** Management, marketing, production and all other business related activities in the automobile industry must cater to its demand characteristics. Some of the important features of the automobiles of the future would be as follows:
 - **Improved Performance:** Performance in respect of driving, reliability, speed and stability would improve enormously during the next few decades. The automobiles of the future would rarely have any performance complaints and if any develop the same would be immediately identified and corrected within a short time.
 - **Increased Creature Comforts:** The automobile of the future will have greatly increased comfort, aesthetics and driving/travelling conveniences. These automobiles will contain a lot of electronic gadgets to facilitate driving/travelling and to diagnose and correct any malfunction.

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- **Increased Safety Features:** Built-in features in the automobiles of the future would reduce and ultimately eliminate auto accidents and driver/passenger injuries resulting there from. These automobiles would be programmed to run automatically on specified tracks/routes and would have built in anti-collision systems.
 - **Rapidly Changing Designs:** Unlike the designs of the past which lasted for a number of years for a model of vehicle, the demand characteristics for automobiles in the future would change very rapidly making a model absolute in a few months. This phenomenon will require designing and production systems that will incorporate rapid changes in automobile designs and specifications.

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- **Production Features:** To cater to the changed automobile demand characteristics the future automobile production will have the following special features:
 - **Small Batch Production:** The traditional assembly line will be an obsolete concept of the 'last century'. Long production runs of thousands of identical parts will be rare. Instead, production, though very fast and accurate, will be required in small batches to meet rapidly changing demand. The automobile factory of the future will be required to process orders within a few hours, orders that presently take weeks or months. The factory will not have the traditional machine tools dedicated separately to milling, casting and welding. All production functions will be performed by a small number of versatile production centers within small locations and in a short time.
 - **Technology:** To cope with batch production, convergence of at least the following three key technologies will be commonly visible:
 - Computer - aided designing (CAD)
 - Grouping of machine tools into flexible manufacturing systems (FMS)
 - Computer integrated manufacturing (CIM).

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- **Automation:** Automobile factories of the future will have fully automated production and service facilities. Automation will be in vogue not just to replace human labour, but for the need to improve quality, reduce production time and cost and above all to make factories more flexible to rapidly changing production requirements. Automation and its resultant flexibility will make it feasible for automobile companies to accept small, non-standardised orders and process them expeditiously.