INTRODUCTION TO THE FUTURE OF TRUCKS USING TMS & FMS
In recent years there has been an exponential growth in the number of logistic and product shipment companies all over the country. This growth has been due to the increasing popularity of online trade. These companies always require vehicles to get their loads from point A to point B, safely, quickly and with no hindrances. The last mile vehicles are of paramount importance as they are the final link between the consumer and the company. There are numerous vehicular options in the market that serve as these last mile vehicles, however none of these options have the tonnage capacity and features, in the given price range, as the product that our team has developed. By separating the load carrier and the cabin, G9 has developed a comfortable, ergonomic and robust product that will serve as the best last mile vehicle to date.

CHAPTER ONE

Motivation

Available for many North American axle/suspension combinations, there’s a Meritor WABCO product that’s optimized for your application. The EX225 is ideal for specialty vocational applications such as bus, fire, emergency, military and heavy linehaul. The MAXXUS is designed for linehaul and medium-duty highway tractors. And PAN family of brakes offers outstanding performance for linehaul trailers. Whichever Meritor WABCO product you choose, you can count on the ultimate combination of safety, performance and value. Here are just a few advanced features that set Meritor WABCO air disc brakes apart: n Brake solutions for all vehicle applications (17.5”, 19.5”, 22.5” and 24.5”) n 20% to 30% better stopping performance and improved fade resistance over drum brakes n Thicker pads mean enhanced durability and longer service intervals n Proven durability and reliability for lower life cycle costs – Longer pad and rotor life – Less time to replace pads – Environmental sealing integrity n Optional radial and axial mountings, rotor and pad shields, and visual and electronic wear indicators n Lightweight ductile and .................. 

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Atmel has developed a versatile GPS tracker useful for real-time asset tracking for theft prevention, location tracking of people, package tracking for long-distance shipping, and historical logging of hiking, and other recreational activities. The design allows logging of current GPS location to a SD Card and also sends data remotely based on location requests and other commands issued over SMS. Important components of the design are a low power, high sensitivity 3-axis accelerometer (BMA150) from Bosch Sensortec, low-cost single chip battery charger MAX1555 from Maxim and a SIM900 GSM module connected to the SAM D20 microcontroller. An onboard (power-only) USB charging port provides a convenient method of recharging the battery ........................................ 26

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ABSTRACT

In recent years there has been an exponential growth in the number of logistic and product shipment companies all over the country. This growth has been due to the increasing popularity of online trade. These companies always require vehicles to get their loads from point A to point B, safely, quickly and with no hindrances. The last mile vehicles are of paramount importance as they are the final link between the consumer and the company. There are numerous vehicular options in the market that serve as these last mile vehicles, however none of these options have the tonnage capacity and features, in the given price range, as the product that our team has developed. By separating the load carrier and the cabin, G9 has developed a comfortable, ergonomic and robust product that will serve as the best last mile vehicle to date.

PROBLEM STATEMENT

To develop a 1.5 Tonner last mile load carrier for the Indian market with a price range of 5-10 Lakhs.

INTRODUCTION

A truck or lorry is a motor vehicle designed to transport cargo. Trucks vary greatly in size, power, and configuration; smaller varieties may be mechanically similar to some automobiles. Commercial trucks can be very large and powerful, and may be configured to mount specialized equipment. Modern trucks are largely powered by diesel engines, although small to medium size trucks with gasoline engines exist in the US, Canada, and Mexico. In the European Union, vehicles with a gross combination mass of up to 3.5 t (7,700 lb) are known as light commercial vehicles. and those over as large goods vehicles.

Mini truck, also called a micro-truck, is tiny but practical light trucks, available in RWD or 4WD version. Generally they fall under sub 1000cc engine category. These vehicles find their use in intra-city low tonnage cargo delivery, like postal and courier services or home delivery of appliances from dealer to the customer i.e. light loads over short distances. In India the Small Commercial Vehicle (SCV) segment was created by the launch of Tata Ace in May 2005. This category can roughly be characterized as sub 1000cc engine and less than 3.5 tones of weight. This segment competes in the prevailing three-wheeler segment on the basis of cost, durability and new pollution control laws. Mini trucks are suitable for short intra-city deliveries, plying on narrow village roads, long highway hauls carrying small bulky loads or even heavy cargo. Before the coming of mini trucks to India, this segment was being catered by three-wheelers. With the Supreme Court of India's ban of overloading of cargo vehicles and restrictions on the entry of heavy commercial vehicles into city, the necessity of an intermediate segment was observed. Tata became the frontrunner to fill the gap by launching the first mini truck of India Tata Ace. With the immense popularity of Tata Ace, many other manufacturers from three-wheeler segment or from Light Commercial Vehicle segment jumped into the SCV segment.
Motivation
Now days there are many small scale business dealers in the city and urban areas, where mini truck driver’s demand is in large scale, so these drivers do not get good facilities in their truck eg. Adjustable seat, legroom space, brakes. So we decide to solve the problem faced by the drivers, by adding features in their trucks regarding comfortless we provide adjustable seats, large cabin space; and accordingly for safety, we provide airbags, disc brakes.

Modifications:-

1. Cabin suspensions –
   - In this paper, a control strategy is presented for an active cabin suspension of a commercial vehicle, that significantly improves driver comfort without impairing the vehicle’s pitch and roll behavior during extreme maneuvers.
   - The suspension consists of 4 idealized 10 Hz bandwidth actuators below each of the cabin’s corners. By means of input output decoupling of the linearized equations of motion and the introduction of an active controller constraint, the system can be transformed into three decoupled Single-Input-Single-Output (SISO) loops.
   - Each of these loops are controlled separately. The controller is evaluated using a number of simulations with a validated tractor semi-trailer simulation model.
   - The controlled active suspension is shown to significantly enhance both driver comfort and attitude behavior. Additionally, the significance of adding passive damping is illustrated.

Stabilizer Bars
- Also known as anti-roll or sway bars, these components work by distributing the weight of a cornering vehicle to the opposite side of the car.
- Adding a stabilizer bar to a vehicle that does not already have one can greatly reduce yawing and swaying.
- Similar to a torsion bar in operation (see Part Two for more on torsion bars), a stabilizer bar runs from one side of the vehicle to the other, attaching to the frame and control arms via a simple bushing arrangement. When the car goes through a turn, the bar begins to twist, but resists motion. This resistance distributes vehicle weight more evenly from side to side, lending the vehicle more stability.
- Stabilizer bars can be added front or rear. Such vendors as Suspension Technology and Eibach manufacture stabilizer bar kits for the aftermarket.

Strut Tower Brace
- A strut tower brace is a simple metal bar that stretches across the front MacPherson strut towers, unitizing the front end by increasing rigidity.
- Open the hood of your car. Locate where the front struts attach to the body of the car -- you’ll see a bolt punching through the top of each wheelwell with a nut tightened down on it. The strut tower brace goes between these two bolts. Simply remove the nut and washer, slide the strut brace over the bolt, and anchor it down with the washer and nut. Easy as pie.
- A lot of aftermarket suppliers build strut tower braces. Be sure to order the correct one for your car and body type. It’s amazing what such a simple modification can do to increase front-end rigidity. You’ll notice the difference right away. And it’s cheap. Most strut tower braces cost around a hundred dollars.
Aftermarket manufacturers of these components include GReddy, Neuspeed, Suspension Technology and Eibach.

2. Emission control methods

A. SCR (Selective Catalytic Reduction) for NOx

Basic Reactions

4 NO + 4 NH3 + O2 -> 4 N2 + 6 H2O
6 NO2 + 8 NH3 -> N2 + 12 H2O

Undesired Parallel Reaction
SO2 + 1/2 O2 -> SO3
NH3 + SO3 + H2O -> NH4HSO4

It is a catalyst installed on the exhaust system of a diesel truck. It sprays DEF into the exhaust stream to mix with exhaust gases to convert to nitrogen and water. Diesel Exhaust Fluid is the mixture of high purity synthetic automotive grade urea and deionizer water that is used in Selective Catalytic Reduction (SCR) systems on diesel engines.
Working of scr.

The method of the invention reduces the emissions of NOx from a lean-burn engine having an exhaust system having an exhaust passage for carrying exhaust gases containing NOx to a reactor effective for selective catalytic NOx reduction, and in one embodiment comprises: feeding an aqueous urea solution from a storage vessel through a line to an injector; returning urea solution from the injector to the storage vessel, the rates of feed and return being sufficient to supply urea as needed to the exhaust gases for NOx reduction and maintain the temperature of the urea solution sufficiently low that it is not permitted sufficient time at elevated temperature to hydrolyze the urea to such an extent that solids precipitate (e.g., below about 140° C.); injecting urea solution into the exhaust gases at an exhaust gas temperature sufficient for SCR; and passing the exhaust gas through an SCR reactor.

In another embodiment, the return is not employed or is not the sole means for temperature maintenance of the urea solution. In this embodiment, a heat exchange fluid such as air or engine coolant can be passed in heat exchange contact with the injector. In this embodiment, the temperature of the urea solution can be allowed to rise above 100° C. as long as the urea solution is maintained at a pressure above the saturation vapor pressure at the temperature.
B. Exhaust gas recirculation

A widely adopted route to reduce NOx emissions is Exhaust Gas Recirculation (EGR). This involves recirculating a controllable proportion of the engine's exhaust back into the intake air. A valve is usually used to control the flow of gas, and the valve may be closed completely if required. The substitution of burnt gas (which takes no further part in combustion) for oxygen rich air reduces the proportion of the cylinder contents available for combustion. This causes a correspondingly lower heat release and peak cylinder temperature, and reduces the formation of NOx. The presence of an inert gas in the cylinder further limits the peak temperature (more than throttling alone in a spark ignition engine).

The gas to be recirculated may also be passed through an EGR cooler, which is usually of the air/water type. This reduces the temperature of the gas, which reduces the cylinder charge temperature when EGR is employed. This has two benefits- the reduction of charge temperature results in lower peak temperature, and the greater density of cooled EGR gas allows a higher proportion of EGR to be used. On a diesel engine the recalculated fraction may be as high as 50% under some operating conditions.
**Working**

NOx is created when nitrogen and oxygen (air) react at high temperature (combustion) and pressure. NOx released through the exhaust into the atmosphere then reacts with Volatile Organic compound’s (VOC’s) and sunlight to form Photochemical Smog, which negatively affects all the living things, in particularly small children and the elderly with Asthma. This form of smog is very long lived in atmosphere, breaking down very slowly.

The EGR system takes a portion of an engine’s exhaust gases, which after combustion have very little oxygen and nitrogen left in them and runs them through a cooler or coolers (using engine coolant or other closed loop cooling system fluid) which lowers their temperature and then using a valve, meters that cooled gas back into the air intake system. This cooled exhaust gas displaces some of the oxygen and nitrogen from the incoming air, which in turn reduces combustion temperature, lowering the amount of NOx the engine produces.

![Diagram of EGR system](image)

**3. Brake**

With decades of accumulated expertise in air disc brake technology, Meritor WABCO has emerged as the clear-cut innovation leader – delivering solutions that continue to set standards in safety, performance, durability, ease of maintenance and cost-efficiency. Air disc brakes began in 1981 with the introduction of our first ArvinMeritor air disc brake. Pioneering spirit has driven us to bring innovation after innovation to the industry ever since, including the introduction of twin-piston air disc brake (EX225) in 2000.
Available for many North American axle/suspension combinations, there’s a Meritor WABCO product that’s optimized for your application. The EX225 is ideal for specialty vocational applications such as bus, fire, emergency, military and heavy linehaul. The MAXXUS is designed for linehaul and medium-duty highway tractors. And PAN family of brakes offers outstanding performance for linehaul trailers. Whichever Meritor WABCO product you choose, you can count on the ultimate combination of safety, performance and value. Here are just a few advanced features that set Meritor WABCO air disc brakes apart: n Brake solutions for all vehicle applications (17.5”, 19.5”, 22.5” and 24.5”) n 20% to 30% better stopping performance and improved fade resistance over drum brakes n Thicker pads mean enhanced durability and longer service intervals n Proven durability and reliability for lower life cycle costs – Longer pad and rotor life – Less time to replace pads – Environmental sealing integrity n Optional radial and axial mountings, rotor and pad shields, and visual and electronic wear indicators n Lightweight ductile and aluminum hub and rotor packages n Integrated service, double diaphragm spring brake and piston-style actuators.
MAXXUS benefits include:
• Operational savings due to lighter weight and increased payload capacity
• Increased pad thickness provides additional pad volume and longer life
• Overall installation package meets OEM requirements
• Engineered for increased operational performance and reduced impact to vehicle chassis
• Service-friendly with radial pad change and factory-sealed lubrication
• Newly designed monobloc caliper and a new reinforced single-piston clamping unit, which enables high brake torque
• Key components are protected by redundant sealings; the guiding system is additionally protected by stable metal caps
• Brake caliper features an advanced surface coating
• Frame-type carrier with radial mounting
• Inboard and outdoor pad rest in the brake carrier
• Fewer components increase reliability and reduce weight
• Spreader plate shields the piston

Trailer Brake System

A brake controller is usually an OEM or aftermarket installed device or module. It is mounted to the tow vehicle's driver's-side dashboard area, and engages a trailer’s electrical braking system either time delayed, or in proportion to the tow vehicle's brake engagement when slowing down or coming to a halt. A brake controller is not needed with a trailer surge braking system unless using modern electric over hydraulic devices. The trailer in this case usually has either electric friction brakes or electric-hydraulic trailer brake actuators.

Most basic brake controllers will generally have a +/- gain adjustment. The tow vehicle operator would set the gain as high as possible but without the trailer brakes locking up after making a few test stops. The heavier the trailer, the higher the gain adjustment would be set and therefore the less chances of wheel lock-up.

An overrun brake (called a surge brake when invented) is a brake system commonly used on small trailers, where the motion of the trailer with respect to the towing vehicle is used to actuate the brake. The early systems were fitted with a spring system which was not very effective. Later systems were fitted with a sliding mechanism within the coupling enables the drawbar to move back and forth relative to the trailer chassis. When the towing vehicle brakes, the inertia of the trailer slides the mechanism, this in turn uses the travel of this mechanism to pull on the brake rod which applies the brakes. The sliding mechanism contains a damper to even out the shock loading transmitted from the tow vehicle. Therefore, the inertia of the trailer provides the force to apply the brakes.
Brake Control Device:

The brake contro has a triple axes motion sensor and it automatically adjusts your brake output. This makes going up and down hills a lot easier and produces sooth and precise stops. There is also no setup required with it’s automatic calibration and leveling.

4. on board diagnosis system:
To detect the fault in the vehicle there are sensors mounted on the vehicle, which delivers various information to ECU. Which is then analysis by ECU and depending on the data available, action are taken by ECU. To carry out this task various sensors like crank speed sensor, cam speed sensor, coolant temperature sensor, boost temperature and pressure sensor and rail pressure sensor are installed on the engine.

Crank speed sensor

- This sensor is used to measure the speed of the crank from which ECU receives the information regarding the speed of the engine and then accordingly will inject the fuel in the chamber. Along with the speed load added is also considered. This helps in better performance of the engine which improvers the efficiency of the engine.
- This sensor is used to measure the speed of the camshaft. If the crankshaft sensor fails to deliver the information due to some failure, occur in the system. ECU will make calculation from the data received from cam shaft and will perform its task.
- This sensor is used to monitor and inform the ECU regarding the state of the coolant. If the required temperature is not achieved by the coolant than ECU does not circulate the coolant and thus, avoids over cooling of engine.
- This sensor is mounted on the outlet of the oil pump. Its function is to collect the information regarding the oil temperature and pressure flowing into the engine. Data received by ECU is then processed and if any fault is in the system then ECU informs to the driver, which helps in avoiding the failure of the system.
- This pressure sensor is fitted on the common rail of the inlet of the fuel. This indicates the pressure at which the fuel is injected into the system. If required it will increase or decrease the pressure as per requirement of the engine.
- The robust intake manifold pressure and boost pressure sensor DS-G3-TF with integrated temperature sensor make it possible to quickly and precisely measure the pressure and temperature of the intake air from turbocharged and non-turbocharged internal-combustion engines. As a result, the sensor supports precise management of the fuel supply and optimization of untreated emissions.

If sensors fail to deliver the information then it will result into following the conditions depending on the sensor fails or in which system fault is arise:
Engine shut down
Torque and speed limitation.
Limp home
5. Design Specifications and Ergonomic Evaluation of Car Seat Dimensional Factors in Seat Comfort

- Stress must be given on ergonomic consideration for seat design in car
- All the requirements of seat design must be incorporated to ensure the comfort of driver and passengers
- The principal body dimensions for vehicle seat design being shown in Figure
- It ranges from 5th percentile woman to 95th percentile man
- Special consideration should be taken for those, who have, for example, long legs and a short trunk, or vice versa, and do not conform to the averaged percentile norms

The contrast has also to be resolved between the extra relaxation enjoyed by the seated person and the constriction of certain organs and the restriction of blood flow through the veins, from the lower extremities of the body.

- There is also greater susceptibility to vibration loads due to the absence of damping characteristics of the legs in an otherwise upright posture.
- The best compromise is obtained when the seated posture minimizes the strain on the human organism imposed by external loads as well as equilibrium between the ligaments and the sections of muscle which act in the opposite sense to them. So a degree of freedom of movement must be provided, holding the body in position
- Sufficient rearward recline of the seat is given to displace the body’s CG behind the ischial contact point, so that arm and leg movement is free from unwanted feedback effects at the other extremities
- This can be provided by obtaining comfort angles through subjective survey

Seating design Pitfall

- The figure shows how the wrong backrest inclination has the potential to cause severe discomfort over a long journey.
- The muscular interaction with vehicle motions, sensed through the seat, is governed by anticipation of (experience) reaction and by a sense of balance.
- The interaction becomes a reflex condition, considerably more energy is required with conventional seat systems, to maintain a relationship with the controls, than is necessary to actual control the vehicle .The choice of cushion springing and damping characteristics as well as the contouring of the seat and squab profiles and the choice of upholstery trimcloth are equally important for ergonomic comfort


In spite of improvements in passive safety and efforts to alter driver behavior, the absolute number of highway fatalities in 2002 increased to the highest level since 1990 in the US.

ESP is an active safety technology that assists the driver to keep the vehicle on the intended path and thereby helps to prevent accidents. ESP is especially effective in keeping the vehicle on the road and mitigating rollover accidents which account for over 1/3 of all fatalities in single vehicle accidents.

In 1995 Bosch was the first supplier to introduce electronic stability control (ESC) for the Mercedes-Benz S-Class sedan. Since then, Bosch has produced more than 10 million systems worldwide which are marketed as ESP - Electronic Stability Program.
In this report Bosch will present ESP contributions to active safety and the required adaptations to support four wheel driven vehicles and to mitigate rollover situations. Worldwide traffic is increasing with more and more vehicles on the road. Considering the different regions of the world, the development of the mobility shows a clear correlation to the gross domestic product. With further economical growth, we will see more increase in mobility and in traffic density throughout the world. This will require additional efforts to furthermore enhance the road safety. The statistics for the European Union demonstrate alarming results. They show a total of 1.3 million accidents for the year 2000 with 1.7 million injured persons and more than 40,000 fatalities. The target of the eSafety Initiative of the European Union for 2010 is set to reduce road deaths by 50%, e.g. by the promotion of intelligent active driving safety systems.
European Safety initiative
Japan has set a similar target and also NA is actively pursuing advances in road safety.

MAIN SECTION

The progress of crash energy absorbing car body design and the standard fitting of airbags significantly improved the passive safety especially combined with the use of seat belts. But many of the serious accidents happen through loss of control in critical driving situations. When the vehicle goes into a skid, a side accident is frequent result. With a reduced protection zone for the occupants compared to front crashes, these accidents show an amplified severity. Especially with vehicles of an elevated center of gravity like sport utility vehicles (SUV) and light trucks (LT) the loss of control with subsequent skidding may even lead to a rollover. Most of the rollovers are caused either by tripping at an obstacle or in the soil. The severity of rollover accidents is extremely high. Accounting for only 2% of the total crashes, they contributed in 2002 with 10.656 fatalities to one third of all occupant fatalities (Fig. 3) in the US.

US Accident fatality statistics Total Accidents
Involved Vehicles: 10.6 Mio
Fatilities
Occupant Fatalities: 32.335

Point of Impact
Frontal crash: 46 %
Side crash: 29 %
Rollover: 2 %

Severity (by fatalities)
Frontal crash: 39 %
Side crash: 23 %
Rollover: 33 %

A study performed by the University of Iowa at the National Advanced Driving Simulator showed a strong impact of ESP on vehicle stability [2]. The primary question was “Does the presence of an ESP system aid the driver in maintaining control of the vehicle in critical situations?”. Based on all analyses completed there was a 24.5 percentage point reduction between situations in which the drivers lost control with the system present and situations without ESP. This constitutes an 88% reduction in loss of control. Looking at the data from an improvement standpoint, 34% more drivers retained control with ESP than without. Based on the study results it was concluded that there is significant and meaningful safety benefit associated with driving a vehicle equipped with an ESP system.

Supporting conclusions are drawn by VW [1]. Based on their accidentology, ESP is considered to avoid 80% of the accidents caused by skidding. VW concludes that the safety benefit of ESP is even greater than that of the Airbag. According to VW a 100% installation rate would result in Germany in a 20% reduction of road fatalities and this even with an ESP installation rate of already 53% in 2003.

Based on the analysis of traffic accidents statistics, Toyota [3] estimated that the accident rate of vehicles with ESP for more severe accidents is approximately reduced by 50% for single car accidents and reduced by 40% for head-on collisions with other automobiles. The casualty rate of vehicles with ESP showed approximately a 35% reduction for both types of accidents.
The results of the studies show a consistent picture of the ESP with remarkable safety benefits. Further potential is available especially with functional extensions for SUV and light trucks concerning rollover mitigation and four wheel drive adaptations. However it is important to say that ESP cannot prevent all accidents or adjust for all driver errors. Essential for a safe road traffic are still appropriate driving practices, common sense and a good traffic judgement.

**STABILIZING CONCEPT**

In critical driving situations most drivers are overburdened with the stabilizing task. According to Foerster [4] the average driver can neither judge the friction coefficient of the road nor the grip reserves of the tires. The drivers are typically startled by the altered vehicle behavior in in-stable driving situations; as a result, a well-considered and thought-out reaction of the driver can not be expected. For that reason the ESP has to be designed to stabilize the vehicle even in situations with panic reactions and driving failures like exaggerated steering. The reason why stabilizing a vehicle in critical situations is so challenging can be shown by considering the physical effects. Steering of a vehicle yields in a yaw moment which results in a directional change. The effect of a given steering angle depends on the actual side slip angle [5, 6]. Only slight alterations of the yaw moment are possible at large side slip angles even for extensive steering interventions which can be seen in Fig. 4. The characteristic side slip angles, where the steerability of the vehicle is vanishing, are dependent on the road friction coefficient. On dry asphalt it is around ±12° as shown in Fig. 4, whereas on polished ice it is in the range of ±2°. The driver experiences in all day traffic situations side slip angle values of typically not more than ±2°.

![Fig. Influence of side slip angle on yaw moment for different steering angles at high tire-road friction [5, 6.]](image)

Fig. Influence of side slip angle on yaw moment for different steering angles at high tire-road friction [5, 6].
So one of the main tasks of ESP is the limitation of side slip angle dependent on the actual friction coefficient.

Even in the range of characteristic side slip angles, where the effectiveness of steering is rather limited, ESP can exercise remarkable yaw moments by brake interventions. The tire characteristic determines the longitudinal slip value $\lambda_0$ where the maximum brake force is generated. The slip value $\lambda_0$ is typically in the range of 10%. Considering the left front wheel during right hand cornering (Fig. 5, wheel 1), the resulting wheel force in free rolling condition $F_R (\lambda = 0)$ is in lateral direction. By adjusting the tire slip to $\Lambda_0$, the maximum brake force $F_B (\lambda_0)$ is applied and by this means the lateral force is reduced to $F_S (\lambda_0)$. The resulting force vector $F_R (\lambda_0)$ is turned relative to the tire thereby modifying the yaw moment, the longitudinal and the lateral forces.

The required yaw moment can be applied by controlling the longitudinal tire slip and in that way employing it as a vehicle dynamics control variable. This approach is utilized with anti-lock and traction slip control, yaw rate control with restricted side slip angle and with a limitation of lateral acceleration for rollover mitigation functionality.

During the last few years the segment of four wheel driven vehicles got more and more popular. The main focus of attention is the range of SUV and LT vehicles that are suitable for use on public roads but also have qualities under off-road conditions. Part of the off-road capacities are due to the elevated center of gravity which augments the susceptibility to rollover. This makes SUV and LT the preferred target for ESP applications. Special adaptations of the ESP system and the control concept are required for the cooperation with a four wheel drive (4WD) power train.
**Rising to the challenge**
In the future, transport demand is expected to increase in line with GDP and trade growth. This raises the challenge of striking a balance between growing mobility needs and environmental protection.

To meet this challenge, all transport modes will need to further improve their efficiency, safety and environmental performance, and to work together in a complementary way.

**Europe’s truck and van manufacturers: world-leaders in green and safe technologies**
Trucks are the benchmark for fuel-efficiency thanks to technologies like common rail injection, automated gearboxes, turbocharging and intercooling. As a result, modern European trucks are a third more fuel-efficient than 30 years ago, producing less CO2 per tonne-km. Market forces are constantly driving further technological advancement because fuel outlays form a significant portion of overall operational costs for commercial haulage operators.

Regarding safety, today’s trucks are fitted with the latest active technologies to prevent accidents from happening, and also with passive systems to protect occupants and other road users should a crash occur. Truck fatalities have come down by 25% in the last two decades thanks to investments in these life-saving technologies.

**Looking ahead: The truck of the future**

The aim of this ‘Truck of the Future’ website and event is to open up the debate on how we can make sure the trucks of tomorrow continue to serve our society – with maximum safety and minimum impact on our environment.
BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates, generally, to truck-tractor vehicles having cab and sleeper assemblies and, more particularly, to a modular cab, sleeper and roof structural assembly for a truck-tractor vehicle.

2. Description of the Background Art

Truck-tractor vehicles are known to have sleeper units for providing sleeping accommodations for truck operators. The truck-tractor vehicle is operated from a cab unit which is positioned in front of the sleeper unit. Generally, the sleeper unit is manufactured integrally with the cab unit (“integral assembly”), or alternatively, the sleeper and cab units are separate (“modular assembly”).

Integral assemblies are configured with a sleeper unit and cab unit in a single structure. Access between the sleeper unit and cab unit can be limited and restricted to a manufacturing technician or assembly worker. Since the sleeper and cab units are provided in a single structure, the sleeper unit cannot be replaced or removed from the cab unit.

Modular assemblies consisting of separate sleeper and cab units are individually mounted to a truck chassis (e.g., the cab unit is mounted to the chassis and then the sleeper unit is mounted to the chassis). Sleeper and cab units can also be mounted to each other with a subframe underneath. Access between the sleeper and cab units is provided through an opening in a front wall of the sleeper unit and a back wall of the cab unit. The sleeper and cab units are connected by coupling fasteners, such as fasteners, brackets and/or beam members. While the modular assembly allows the sleeper unit to be replaced or removed from the cab unit, the coupling fasteners between the sleeper and cab units can reduce the available usable interior volume.

SUMMARY OF THE INVENTION

In accordance with the present invention, a modular cab/sleeper/roof structural assembly is provided for a truck-tractor vehicle comprising a top-free cab unit having a front wall, opposing side walls, and a bottom portion. A top-free sleeper unit positioned behind the cab unit has a rear wall, opposing side walls, and a bottom portion. Fasteners couple the cab unit and the sleeper unit such that an upwardly opened carriage assembly is formed. A unitary roof member fixedly encloses the opened carriage assembly and forms an integral modular unit. The unitary roof member has a front portion connected to the front wall of the cab unit, a rear portion connected to the rear wall of the sleeper unit, and opposing side portions connected to the opposing side walls of the cab and sleeper units.

A method of assembling a top-free cab unit, a top-free sleeper unit and a roof member to form a modular cab/sleeper/roof structural assembly for a truck-tractor vehicle is also provided. The method includes
aligning an open rear portion of the cab unit with an open front portion of the sleeper unit, joining the aligned cab unit and sleeper unit to form an upwardly opened carriage assembly, enclosing the upwardly opened carriage assembly with the roof member, and joining the opened carriage assembly and the roof member to form an integral modular unit.
GPS TRACKER

GPS tracker allows you to never lose track of anything by working out exactly where it is. It's an ultimate gadget to prevent a vehicle from being stolen, monitoring the route of a delivery vehicle over its journey, or even to monitor high-valued assets in transit.

Modern trackers available on the market can work in different ways. While some passive tracking systems store data locally, for instance, on an SD card, others can send this information via modem to a centralized database regularly or at specific times upon request. Some even support large color map displays to visualize this data. GPS trackers have improved considerably in terms of size, power and other capabilities with methods to correct errors in measurement and advanced signal processing techniques.

GPS For People/Asset Tracking & Theft Prevention:
Atmel has developed a versatile GPS tracker useful for real-time asset tracking for theft prevention, location tracking of people, package tracking for long-distance shipping, and historical logging of hiking, and other recreational activities. The design allows logging of current GPS location to a SD Card and also sends data remotely based on location requests and other commands issued over SMS. Important components of the design are a low power, high sensitivity 3-axis accelerometer (BMA150) from Bosch Sensortec, low-cost single chip battery charger MAX1555 from Maxim and a SIM900 GSM module connected to the SAM D20 microcontroller. An on-board (power-only) USB charging port provides a convenient method of recharging the battery.

**Smart Real-time Vehicle Tracking System:**

Here is a reference design from ST which implements a smart vehicle tracking system based on GPS/GSM/GPRS. A vehicle unit gathers GPS information such as location coordinates, time, date, speed, in-journey distance traveled and satellites fixed, and sends the data over GPRS to a remote web server application where it can be viewed on a map.

The same data is also shown on a local LCD display. Additionally, the design uses several MEMS sensors including a 3-axis accelerometer and gyroscope for theft detection and sensing car lift. For the
vehicle unit, the design utilizes a STM32 MCU, a Telit GPS (SL869) module and SAGEM GSM/GPRS module.

Low-cost USB Tracker For Laptops/PCs:

Here is a GPS USB solution from Maxim Integrated which provides high-precision position information with quick acquisition times. Together with the GeotateSM GPS software installed in a PC or laptop, it forms a complete low-cost high-sensitivity GPS solution. The design utilizes the MAX2769, a global navigation satellite system (GNSS) receiver covering GPS, GLONASS, and Galileo navigation satellite systems on a single chip. A USB microprocessor provides a full USB interface with a PC or laptop.
Multi-functional GPS Tracker:

Here is a high performance, small size, and low BOM cost GPS receiver for a wide range of GPS applications such as mobile handsets, PDA’s, embedded PCs, and automotive applications. The design is built around a Maxim’s low cost MAX2769 universal GPS receiver covering GPS, GLONASS, and Galileo satellite navigation systems on a single chip. Further, it requires only a few external components to form a complete low-cost GPS receiver solution.

Important Design Features

- Dual-Input Uncommitted LNA for Separate Passive and Active Antenna Inputs
- Integrated Active Antenna Sensor Which Can Autoswitch the Antenna Input
- The I and Q Channel-Select Filters Can Be Selected as Either Third or Fifth Order
- Provides 110dB Cascaded Gain and a 1.5dB Cascaded NF in LNA1 Mode
- The IF Output Is Adjustable in 63 Steps Between 0MHz and 12.5MHz
- Can Be Used in Preconfigured States that Do not Require Programming Through the 3-wire SPI™ Interface
TMS

What is TMS?

A transportation management system (TMS) is a subset of supply chain management (SCM) that deals with the planning, execution and optimization of the physical movements of goods. In simpler terms, it's a logistics platform that enables users to manage and optimize the daily operations of their transportation fleets.

Benefits of a Transportation Management System (TMS)

- 1) Reduce freight expenses. One of the greatest benefits that a TMS provides is reducing freight spend.
- 2) Track deliveries in real time.
- 3) Increase customer service.
- 4) Improve warehouse efficiency and productivity.
- 5) Increase supply chain efficiency.

When do you need TMS?

TMS provides supply chain managers with the opportunity to look back and analyze past decisions through data storage capabilities.
Some businesses and organizations use calls, spreadsheets, messages and email to cater for their various transportation components; all these might be costing them huge amount of money annually. A data repository will give a supply chain manager the chance to easily identify the actions that produced the best results and which actions give less-than-optimal results.

A great TMS can give insight through reports, dashboards, charts and other features that enable better decision making and lead to cost savings.

Additionally, most TMS solutions can be accessed through cloud technology. With little barriers to entry, ease-of-use and modest upfront costs, cloud-based applications are generally available and fast-becoming the standard across different industries.

**FMS**

Fleet (vehicle) management can include a range of functions, such as vehicle financing, vehicle maintenance, vehicle telematics (tracking and diagnostics), driver management, speed management, fuel management and health and safety management. Fleet Management is a function which allows companies which rely on transportation in business to remove or minimize the risks associated with vehicle investment, improving efficiency, productivity and reducing their overall transportation and staff costs, providing 100% compliance with government legislation (duty of care) and many more. These functions can be dealt with by either an in-house fleet-management department or an outsourced fleet-management provide
The Benefits of implementing a Fleet Management System

- **Reduce operational costs and increase efficiency:** By optimizing fleet’s fuel efficiency, managing drivers performance, streamlining reporting and improving routing, business can save plenty of money on their operational costs. This helps them increase their profitability.

- Improve fleet safety: Having a fleet management system in place can provide an opportunity for better safety habits. Fleet Managers can be able to analyze patterns, behaviours and habits of individual drivers. With this information, businesses can be able to make informed decisions on how to improve driver habits and more.

- Improves customer service and satisfaction: A fleet management system improves cargo delivery times. The system ensure businesses are able to provide a more effective and efficient service to all your clients regardless of the operation you run. When your customers get high quality service, it improves the overall customer satisfaction they will be more likely to stay loyal to your company and return for additional service.

- Automated fleet reports: Fleet management systems deliver reports hourly, daily, or even weekly depending on the criteria you need fulfilled. This helps you to understand the habits of your fleet to be able to make adjustments based on the analysis.
TATA ACE

- Engine Tata 475 TCIC (BSIII)
- Engine capacity 1405 cc
- Max engine output 70 hp @ 4500 rpm
- Max engine torque 13.8 kg·m @ 2500 rpm
- Clutch and transmission Clutch Single plate dry friction diaphragm type
- Gearbox Synchronesh 5+1
- Steering Power assisted hydraulic Rack & pinion
- Suspension
  - Front: MacPherson strut with anti roll bar
  - Rear: Leaf Spring with Telescopie Shock absorber
- Brakes
  - Front "Hydraulic dual circuit, vacuum assisted, automatic wear adjuster Disc brake"
  - Rear Drum Brakes
- Wheels & Tyres Tyres 165 R14 & 175 LT 8PR
- Dimensions
  - Wheelbase 2380 mm
  - Width 1565 mm
  - Length 4340 mm
  - height 1858 mm
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Market Trends

- Freight Transport market in India is expected to be worth US$ 307.70 Billion by 2020.
- In India road freight constitutes of 2.2 million heavy duty trucks and 0.6 million light duty trucks.
- 60% of the goods in India are transported by road.
- Intra city shipment is dominated by light duty trucks like Tata Ace, Bolero Pickup and Ashok Leyland’s Dost.
- These trucks hold 61% of sales shares in the Indian Truck market.

Technology Options Considered

Emission Control
- SCR (Selective Catalytic Reduction)
- Exhaust gas recirculation

Braking system
- Air disc brake
- Overrun brake (Trailer)

On Board Diagnosis System
- Crank speed sensor
- Cam speed sensor
- Coolant temperature sensor
- Oil temperature and pressure sensor
- Rail pressure sensor
- Boost temperature and pressure sensor

Stability
- Shocks
- Springs
- Stabilizer Bars (Suspension)
Ergonomic Technology Options Considered

The Bosch Electronic stability control (ESP)

• In spite of improvements in passive safety and efforts to alter driver behavior, the absolute number of highway fatalities in 2002 increased to the highest level since 1990 in the US.

• ESP is an active safety technology that assists the driver to keep the vehicle on the intended path and thereby helps to prevent accidents. ESP is especially effective in keeping the vehicle on the road and mitigating rollover accidents which account for over 1/3 of all fatalities in single vehicle accidents.

• In 1995 Bosch was the first supplier to introduce electronic stability control (ESC) for the Mercedes-Benz S-Class sedan. Since then, Bosch has produced more than 10 million systems worldwide which are marketed as ESP - Electronic Stability Program.

Solution of the Problem

FIGURE 1
NEW TECHNOLOGIES (FUTURE IMPROVEMENT)

DRIVERLESS TRUCKS

Daimler AG unveiled a prototype driverless truck at last year’s International Commercial Vehicles show in Hannover, Germany, for example. With a sleek, extended tractor front and an array of LED lights that replace traditional headlights, Daimler claims its Future Truck 2025 could be the next generation in trucking – and could reduce fuel consumption and related emissions while improving safety.

The big rig bristles with communications technology: it navigates using its Highway Pilot system, enabled by a collection of cameras and radar sensors, while continuously transmitting its position to other drivers and traffic control centers. For times when it has a driver behind the wheel, the truck also has a Blind Spot Assist feature to help with lane changing and to alert drivers about other vehicles and stationary objects on the road.

From a technology standpoint, anyway, driverless trucks may not be far off: many cars on the road today already have collision and lane-changing assistance, and manufacturers are increasingly installing collision-avoidance systems to help stabilize trucks when they are at risk of rolling over – and to warn drivers when they are drifting out of their lanes.

For trucks already on the road, manufacturers are working to reduce idling time, which can eat up half a truck’s operational time and 8% of its fuel. Drivers often leave their truck engines idling in order to heat or cool their vehicles while they sleep, but some new engines automatically shut down when the weather isn’t hot or cold enough to warrant running the heating or air conditioning.

“It’s really small gains across the whole truck, a lot of small opportunities,” said Mike Roeth, trucking operations lead at the North American Council for Freight Efficiency, which partners with Richard Branson’s Carbon War Room to make trucking more fuel efficient.

Automated manual transmissions

By adopting many of these solutions, some fleets – notably Freightliner’s Cascadia Evolution – have managed to top nine miles per gallon, compared to the long-standing industry average of six mpg. A demonstration truck from Peterbuilt Motors has reached 10.7 mpg.
The Evolution line itself has evolved its efficiency features from 2007, when it first arrived on the scene. In 2014, it added what’s called “automated manual transmissions” to all of its trucks.

Unlike fully automatic transmissions, which use hydraulic pressure – and a torque converter – to change gears, automated manual transmissions transmit power through metal gears, which makes them more fuel efficient.

These transmissions, which – like automatic transmissions – take the responsibility for shifting gears away from drivers, are more expensive, but can vastly increase efficiency. TJ Reed, Freightliner’s director of product strategy, said that their widespread use has been a game changer for the company.

“We were fully ramped up in 2014 and it’s really amazing. The market is significantly switching from manuals,” Reed told the Guardian. “The concept of running at a lower RPM, that’s going to be a key driver of fuel economy in the future and the automated manual transmission is a technology that enables that.”
LAMBDA SENSOR

ABILITIES

1. Lead-free sensing technologies;
2. Price reductions in real terms;
3. Increased longevity and reliability; Improved performance across increasingly wide environmental ranges and Reduced calibration and test requirements.

Why is Lambda Important?

1. Lambda control is necessary for peak combustion efficiency in the Engine.
2. Lambda control is necessary for peak CAT efficiency.
3. Lambda Control Improves Reliability, Fuel Economy and Lowers Emissions
HEATED OXYGEN SENSOR

Engine-Out Gas Values

Engine-Out Gas Values

[Graph showing engine-out gas values]
Calculating A/F Ratio from Lambda

Lambda = 1.000 when the Oxygen available and Combustible Oxygen demands are in balance.
This is the point of perfect stoichometric balance.
At this point the A/F ratio is 14.71 to 1.00 for Gasoline. Thus, A/F = 14.71 x Lambda

Sensitivity to Combustion Efficiency

(Pre CAT vs Post CAT)

- Brettschneider Lambda uses all the oxygen-bearing and combustible-bearing gases.
- Balance Equation - Calculation not affected by the degree of oxidation
- Method is insensitive to combustion efficiency. Either Pre-CAT or Post-CAT gases may be used.

Lambda for Emissions Control

- \( \lambda = 1.000 \) when Oxygen available and \( \lambda \). Combustible demands are in balance. \( 1.000 \) at 0.5-1.0 Cycles/Sec=\( \lambda \).
- ECM controls using ‘lambda sensor’ input. 0.980 to\( \approx \lambda \)
- 3-Way CAT operation requires 1.020
- Lambda can be confirmed by exhaust gas measurement, either pre or post CAT.
Lambda for Fuel Control Diagnostics

- \( \lambda \) calculated from exhaust gas indicates air fuel mixture independent of the engine controls.
- \( \lambda \) calculated from exhaust gas indicates airfuel mixture independent of combustion efficiency.
- Cold (Open Loop) vs Hot (Closed Loop) vs CAT light-off operation can be evaluated.
- \( \lambda \) can be used to tune systems which do not have closed-loop control

Qualifying EGA gas tightness prior to Lambda Calculation

- High Combustion Efficiency: Measure O2 post CAT - every 5% air leak adds 1.0% O2 to gases.
- Low Combustion Efficiency: Add CO and CO2 - should equal 15% for Gasoline.
- Compare both Methods. If O2 indicates air dilution - then confirm this with low CO and CO2 sum. They should agree

Symptoms of a Bad or Failing Oxygen Sensor

The first line of defense is the Check Engine Light. The Check Engine Light will illuminate if you have a bad or failing oxygen sensor. As soon as this light comes on, contact a professional automotive technician for a Check Engine Light inspection. This light can come on for many different reasons, so it is important to have it looked at by a professional who can correctly diagnose the exact cause. If you have high a mileage vehicle, there's a good chance it has a bad oxygen sensor that needs to be replaced
The **pre-cat** sensor is fitted into the exhaust pipe before the catalytic converter, and cars using the new EOBD2 also have a **post-cat** lambda sensor. ... They reacts to the oxygen content in the exhaust system and produce a small voltage depending on the air/fuel mixture seen at the time

**Is bank 1 sensor 2 upstream or downstream?**

**Bank 1** is where the Number 1 cylinder is located. This is always the forward most cylinder. So then if your diagnostic code is B1 S2 that means **Bank 1 Sensor 2** downstream (post-cat). If its B2 S2 that means **Bank 2** (opposite **Bank** to **Bank 1**) and the **downstream** after cat o2 **sensor**.
DRAWBACKS

SIGNS OF BAD OXYGEN SENSOR
OXYGEN SENSOR IN A CAR

The automotive oxygen sensors are rugged components, considering the operating environment they are placed in. With the passage of time they start to wear out and their performance starts deteriorating quite rapidly. These deteriorations are generally caused by substances like lead, silicone, sulphur, oil ash and even some fuel additives. Some environmental factors such as water, splash from road salt, oil and dirt too may cause this deterioration.

€ Effects

With bad oxygen sensors in cars, the emissions start going up i.e. the time taken to react to changes in the air-fuel mixture slows down. This causes more fuel consumption and may also damage the converter.

€ Diagnosis

For better functioning of your system check your automotive oxygen sensors quite often. The output from the sensor can be easily read by using scan tool or digital voltmeter. In case you are not familiar with the diagnostic processes you can certainly get in touch with some professionals like SJ Automotive who are leading automotive oxygen sensors manufacturer.

When it comes to leading automotive oxygen sensors manufacturer, it is recommended that you choose a company whose auto spare parts are designed with cutting edge technology, top quality and global competitiveness. A reliable company that offers automotive oxygen sensors will also be a trusted aircon compressor manufacturer.

BAD CATALYTIC
Misfire from bad spark plugs/wires, or an excessively rich fuel mixture are the leading causes. Once a catalytic converter has gone bad, you'll probably get a check engine light, and fail emissions tests. As things get worse, you can expect a bad smell, loss of power, poor acceleration, engine stalling, etc.
SWOT Analysis

Strengths

- User Friendly
- Unique Design
- Large Load carrying space
- State of the art braking system
- Ergonomically optimized
- Spacious Cabin
- Low emission rate of NOx

Weakness

- Relatively Higher Cost.
- Turning radius is greater due to separate load carrier.
- Increased dependency of the driver on Electronic stability control.

Opportunities

- Logistic management companies.
- Two separate load carrying variants.
- Could be a revolution in the last mile carrier vehicle industry.
- The cabin is also individually available for sale.

Threat

- The design is very unique for the Indian market but customer acceptance would take a while.
- The companies would have to purchase the cabin and the load carrier separately.
Costing Analysis

- Total Cost Price: Rs 6,40,000 (Basic Variant), Rs 7,10,000 (Full Shell Variant)
- Diagnosis System: Rs 35,000
- Ergonomic design cost: Rs 10,000
- Cabin Suspension: Rs 15,000
- Exhaust gas recirculation system: Rs 10,400
- Overrun Brakes: Rs 12,000
- Brake Controller: Rs 10,000
- Air Brakes: Rs 3000
- ESC System: Rs 15,000
- Engine: Rs 1,50,000
- Vehicle GPS Tracker :Rs 10,000
- Fleet Management System Software :Rs 9000
- Tyre Cost (6 Tyres): Rs 30,000
- Chasis material + Fabrication cost: Rs 1,50,000
- Lights and Electrical systems cost: Rs 70,000
- Total Cabin Price: Rs 5,10,000
- Carrier Price: Rs 1,30,000 , Full Shell Carrier Price: Rs 2,00,000
Summary/Conclusions

Concept building is an important step towards the development of an Affordable, reliable and modern automobile. The above context is related to the same concept and ideas which can be applied in the real world situation to build a competitive pickup truck which can dominate the current market by providing a combo of innovative features such as safety, drivability, comfort etc.

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