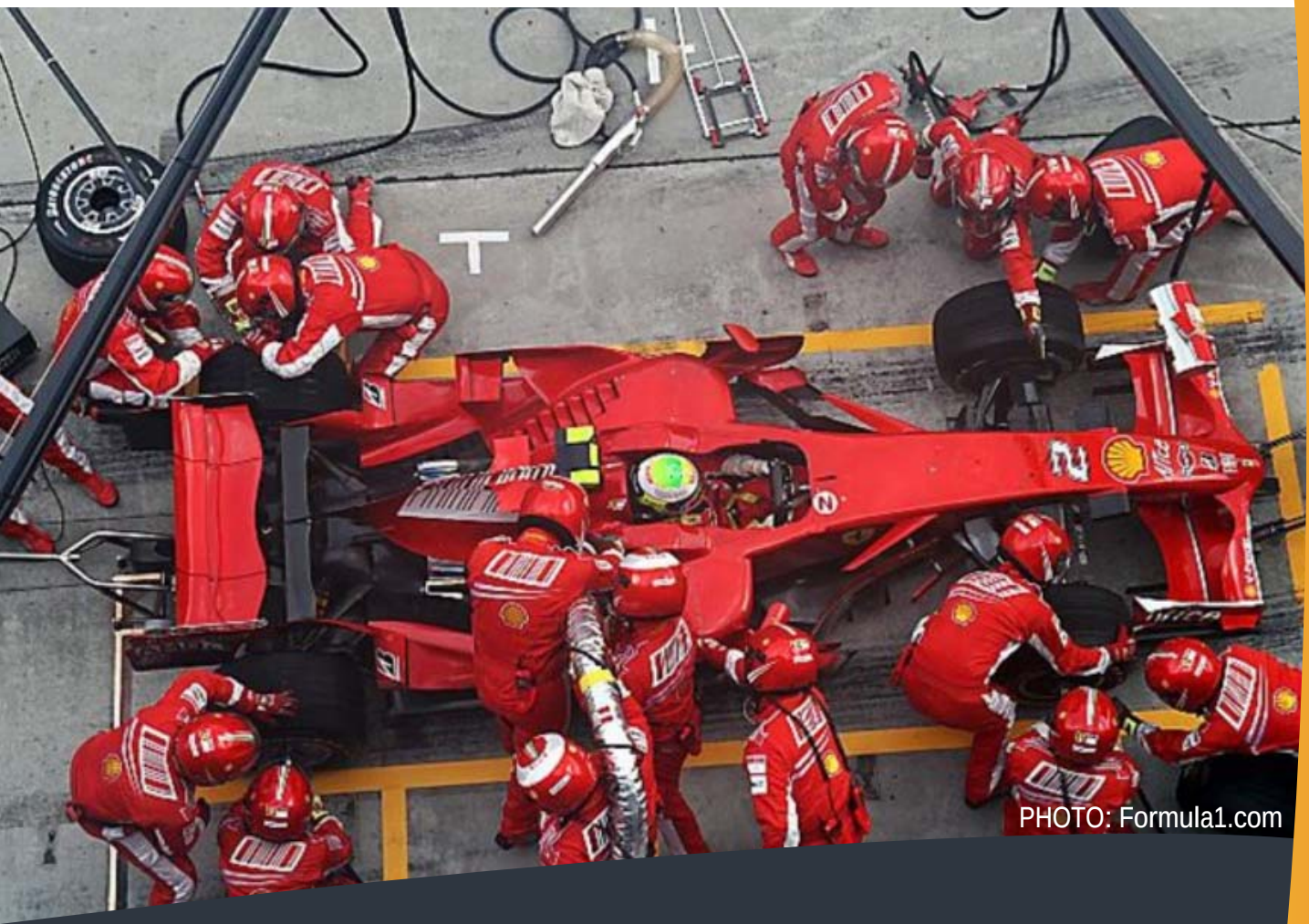
YOUNG ENGINEERS CLUB

SINGAPORE POLYTECHNIC SP



Engineering A Winning Formula One car

Engineering a Winning F1 Car

Behind every winning F1 driver, is group of passionate engineers, working all year round to improve their Formula One racing car. This fascinating vehicle involves some of the most exotic engineering known to humanity. With speeds up to 360 kilometres per hour, a F1 fuel delivers petrol faster than water flows out of your kitchen tap!

PHOTO: Formula1.com

CONSTRUCTION

PHOTO: Formula1.com

The cars are constructed from composites of carbon fibre and similar ultra-lightweight (and expensive to manufacture) materials. The minimum weight permissible is 620 kg including the driver, fluids and on-board cameras. However, all F1 cars weigh significantly less than this, some as little as 440 kg, which is really light as compared this to a Toyota Corolla Altis saloon car which weighs around 1,200 kg. So teams add ballast to the cars to bring them up to the minimum legal weight. The ballast is normally made from Tungsten and is mounted on the lowest point of the car's underbody in order to keep the centre of gravity down.

AERODYNAMICS

An important key to engineer a winning car is aerodynamics, which is the study on the motion of air when it interacts with a moving object. Understanding the motion of air around an object enables the calculation of forces and moments acting on the object.

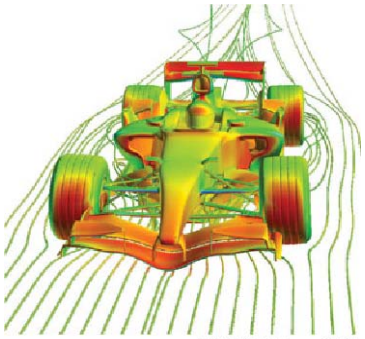


PHOTO: Renault F1

One primary concern of the aerodynamic engineer is the creation of downforce to help push the car's tyres onto the track. This helps F1 driver

to steer his car around corners and bends at high speed. At 160km per hour, a Formula 1 car uses aerodynamics to generate its own weight in downforce - so they could theoretically drive upside down on the roof of a tunnel!

STEERING WHEEL

PHOTO: Formula1.com

When F1 driver Rubens Barrichello threw his steering wheel out of the car during Monaco race in 2010, the electronics engineers and the accountants at Williams will have screamed. Those things are packed full of incredibly complex electronics and are expensive – over S$50,000 a piece!

F1 drivers have no spare concentration for operating fiddly controls. Hence the controls and instrumentation for modern Formula One cars have almost entirely migrated to the steering wheel itself.

The steering wheel can be used to change gears, apply rev limiter[1], adjust fuel air mix, change brake pressure and call the radio. Data such as rpm, laptimes, speed and gear are displayed on an LCD screen.

ENGINE

Every team strives to have the most power on the racing track. Hence, the engine of a modern Formula One car is one of the most highly stressed pieces of machinery on the planet. The engines are amazing. They generate some 600 kilowatts at around 18,000 rpm. Revving at maximum of 18,000 rpm, a modern Formula One engine typically consume 650 litres of air every second, with race fuel consumption around 75 litres for every 100 kilometres.

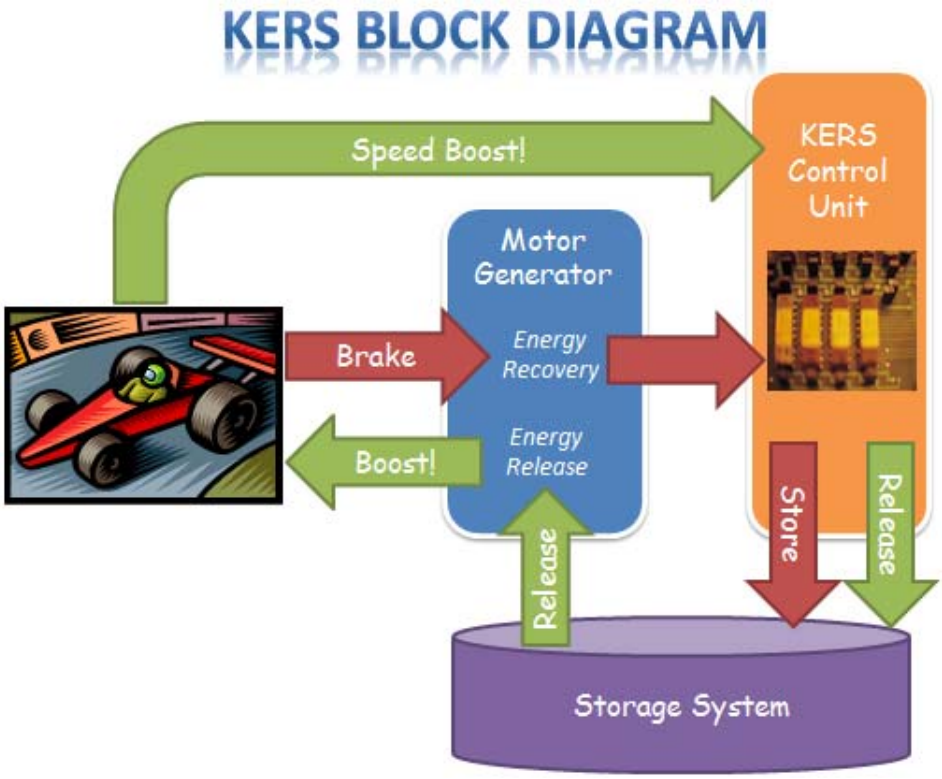
PHOTO: Formula1.com

[1] Rev limiters are devices are fitted to prevent an engine reaching the point at which it develops maximum power.

KINETIC ENERGY RECOVERY SYSTEMS (KERS)

Year 2009 saw the introduction of a brand new technology, which in theory makes the cars more environmentally friendly. Kinetic Energy Recovery Systems (KERS) are devices used for converting some of the waste energy from the braking process into more useful types of energy which can then be used to give the cars a power boost.

KERS is based around the fact that energy cannot be created or destroyed, but it can be endlessly converted. When you drive down the road your car has kinetic energy. When you brake, that kinetic energy is mostly converted into heat energy. In most cars that heat energy is wasted. However in a KERS equipped car, when the driver brakes a portion of the kinetic energy is stored in the car. When the driver presses his boost button that stored energy is converted back into kinetic energy and gives the car about an extra 85bhp for just under seven seconds.



THE ART OF ENGINEERING A WINNING F1 CAR

The job of the scientist is to discover phenomena that are already there, but currently unknown to humans. The job of the engineer is creative - to design and build something that has never been built before. You could say that today, in the design of the Formula 1 car, engineering comes closest to art.