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BMW S100RR Report

Introduction to Automotive Engineering ACHA4009

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1Introduction

The aim of this report is to understand the different fundamentals of the BMW S100RR and to see if it can still be a viable option to sell in the current state of the motorbike industry. I will do this by looking into some of the key aspects of the bike and of the industry. The bike that will be looked into is shown in Figure 1.



Figure 1 – BMW S100RR

2 Impact of the Topics

2.1 Engine

The BMW S100RR is a 4-Stroke in-line engine (BMW, 2022) which is the same as most other 1000CC sports bikes in the industry at the moment. This is because, in relation to 2-stroke engines, they can be more durable as they run at a lower RPM (BerrymanProdcuts, 2022). With them running at a lower RPM that will also make them quieter which is a lot more suitable for city roads as there will be less noise pollution throughout them but also very suitable for the rider as it means they have less risk of getting long term hearing problems from a longer rides. Another benefit of a bike running at a lower RPM is that they are more fuel economic which in the current state of the fuel market is a very desirable trait from a vehicle. Another reason a 4-stroke is chosen over 2-stroke is that a 2-stroke requires premixed oil and petrol to fuel the engine, while 4-strokes do not (BerrymanProducts, 2022).

2.2 Materials

Majority of the BMW S100RR is made with cast aluminium such as the frame and the wheels. This is because aluminium has a good strength to weight ratio (K.Tudor, 2022). This is done as bikes cannot be too heavy as there needs to be good power to weight ratio as if there is too much weight the bike will be a lot slower and a lot harder to handle for a rider especially if ridden on track. When a rider is riding on track, they must lean the bike into a corner so if it weighs more, it will take them a lot more time and strength to pull it into the corner and get it back up straight and if not done right could lead to the front-end giving way and the rider falling. Another advantage of using aluminium for the bikes frame compared to using steel is that aluminium has more flex meaning that it makes the bike more comfortable to ride.

2.3 Sustainability

The engine of the S100RR is an EU4 which is the norm for bike engines at the moment in the market. It also has closed-loop 3-way catalytic converters (BMW, 2022). This system achieves 3 things simultaneously:

1. Reduction of nitrogen oxides to nitrogen and oxygen;
2. Oxidation of carbon monoxide which turns carbon dioxide;
3. Oxidation of unburned hydrocarbons (unburned or partially unburned fuel) it turns into carbon dioxide and water (D.Bagacean,V.Dan,I.Blebea, 2013)

This means that the engine releases less green house gasses and other harmful gasses into the atmosphere. Another part of the engine that affects sustainability is the fact is that it's a 4-stroke. This is because it allows the bike to run at a lower RPM making it more fuel efficient when compared to a 2-stroke bike. Another factor that affects the sustainability of the bike is the materials and processes used to make the bike and with being made mainly out of cast aluminium it is very costly carbon wise as it takes a lot to shape into what it needs to be

2.4Aerodynamics

When looking at bikes, the aero impact of them is quite slim as they are very small compared to other vehicles on the road, but their impact can differ because of the rider and the type of bike. For example, a naked bike has a worse aero coefficient than a sports bike as the sports bike has fairing and a body to make use of the air passing it by, whereas the naked bike has nothing to divert the air and it will pass onto the rider meaning it will be a bit more uncomfortable for them especially at high speeds as they are having the air pushing against them. This is another reason the S1000RR is made more comfortable for the rider as they can tuck themselves behind the fairing and windshield so they will have less air pushing against them and the bike will become less draggy as the air would pass straight over the rider. Another factor that can affect the aero flow of the bike is the size of the rider. This is because a smaller rider will be able to tuck into the bike and seat easier making the airflow smoother rather than a taller rider as it is harder to tuck into the bike as their arms could stick out and affect the aero.

2.5Hybrid

At the moment there are no models of the S100RR that are hybrid as the technology for hybrid bikes is in a very early stage as, unlike cars, there is less space to work with on a bike. BMW have released a bike model with hybrid implementation, but the model is dramatically different to a sports bike like the S100RR as the R1200GS xdrive Hybrid is an adventure class bike which is taller than sports bikes allowing for more room in the engine bay. The technology for electric bikes is more evolved than hybrid as with electric you are not having to implement it on top of an engine it can be its own thing.

2.6Computational Methods

The main computational system on the S100RR is the dashboard as there are not many other electronic systems that a rider can use outside of it. The dashboard allows the rider to control their electronics package which would include Traction Control, Engine Braking, etc, show the MPH and RPM the rider is doing at the current moment. This means that the bike is computing a lot of data within a very short amount of time. On top of presenting a dashboard for the rider to use and working the electronics package, the computer on the bike must run the engine management system which is a complex system which requires a lot of raw data from sensors in every part of the engine. All these functions and systems are vital to making the bike rideable and provide the rider with a lot of knowledge about his own bike in a way that is understandable to him rather than providing him with raw data which is hard to understand for a normal person.

2.7 Control Systems

The BMW S100RR has a lot of control systems as it is a sports bike that is made for track days and racing which means the rider has a lot of aids that will enable them to have a more comfortable ride and a stabler and safer ride at high speeds. One of these systems is traction control which is a substantial aid on track and on roads. This system limits the RPM the bike can put out in one go to stop the rear tyre from spinning up meaning that the rider would lose control of the bike and fall off. This system is very useful on track bikes as it means the rider will use up less of the rear tyre and not overheat the rear tyre so the tyre will not give out during mid corner causing a tank slapper and sending the rider over the handlebars which could cause a severe injury. This is also helpful on roads as it means when riding on wet roads that the bike is easier to control and maintains grip. Another control system that will provide the rider aid is anti-wheelie. This uses sensors on both wheels to make sure they are both rotating at the same speed and if there is a rise in the front wheel to then limit the RPM to keep the front wheel down. This is more useful on track as a rider will want to get on the power straight away which would lead to a wheelie which would lead to them having less speed down the straight. The biggest control system on the bike is the Engine Management System as it has to do a lot at once. This provides the rider with everything they'd need to know about their bike such as RPM, MPH etc. It shows this in a way the rider can understand so they aren't having to figure out what is going on plus riding making it simpler for them. Another big benefit this provides is that it can detect a fault in most parts of the engine and will display that to a rider so they can get it fixed as soon as possible keeping the rider safe from having any big failure on the road or track.

2.8 Suspension

The suspension on the S100RR is adjustable which is perfect for a track bike as it allows for the rider to make it perfect for the track. For example, if the rider was on a very smooth circuit they might want a stiffer suspension as there won't be many bumps to deal with, whereas on a bumpy circuit where you may also use more kerbs they might want a lot softer suspension to make the ride more comfortable.

3Current State of the Industry

The BMW S1000RR is quite suitable for the current motorbike market as it has a lot of modern features required and more. It's a bike that for a rider, on roads, is a comfortable ride and is economic fuel wise as it has a 4-stroke engine. For a circuit rider it is perfect as it has an adjustable electronics package and suspension meaning they can adjust it for any condition to make it smoother and quicker around a track. One of the few downsides is how unsustainable the material is that is used to make it but there many alternatives that can do the same job as well.

4Conclusion

In conclusion, I think that the BMW S100RR is a suitable fit for the current motorbike market and will be for few more years to come. To keep this bike in the industry for another couple of years BMW should look into making the bike more sustainable. Either by finding a suitable material replacement or by looking into making the bike hybrid.

5References

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