The Stages of Engineering Design of the V-Rod Harley Davidson Motorcycle

The first step in the engineering design process is to recognize a need in the company or project. Harley Davidson was losing customer base due to customers wanting speed over older style. Under this step of the design process there are two sub steps one to create a market pull to fix the need and two having a technology push. The Harley Davidson Company’s engineers found a market pull of younger motorcycle riders who wanted faster more modern looking motorcycles. The technology push was in making the new type of bike, because Harley had never made a bike like this before and during the process of building the bike they would encounter problems that would make for the engineers to push and find new technology to make the bike usable and sustainable on the roads.

Defining the Problem is the next step in the engineering design process. The problems with the typical model of a Harley Davidson bike was that riders had seen faster and slicker bikes and their customer base was moving away from the company. They wanted to create a new motorcycle from scratch that would combine the speed of a dragster motorcycle with the Harley Davidson Style and bring their customers back to the business and also bring in a new customer base.

One of the larger steps an engineer has to go through before he/she can create a real product is gathering information. Harley Davidson looked at their own dragster motorcycle team and decided to take the VR 1,000 engine off the motorcycle and use that engine as a base. They wanted a combination of a street safe engine and a dragster engine so they collaborated with the Porsche engine facility to come up with a new engine design of the motorcycle using the VR 1,000 as a base engine model. They also looked at the shape of there dragster bike and other bikes the Harley had already created to combine the two to be able to get the speed and style of the dragster but still the classic look of a Harley. In the Engineering design process you come back to this step multiple times because once you think you have enough information you will probably encounter a new problem. In any of the steps you can and should go back to them to make your final product the most efficient and best it can be.

The next step in the engineering design process is generating conceptual ideas. The engineers who designed the bike had to come up with multiple designs that would work best for the bike. Once they came up with these designs, they would choose the most efficient design. Some ideas that they needed to come up with included creating a new frame, fuel tank, and radiator. The new frame would need to be able to support the speed and power of the engine. They had to decide whether to use a plastic or steel fuel tank. In most previous bikes, they used steel bikes but they needed a new, efficient way to fit the tank into the v-rod. The new radiator needed to be more efficient at cooling the engine while still providing airflow at higher speeds.

After generating conceptual ideas, the engineers needed to compare, combine, and select ideas
for the new motorcycle. They would test each design, decide what they liked about it, then go back to the drawing boards to create something new. This process was repeated for each part of the bike. It took many different designs to perfect each part.

The bike designers needed the bike to ‘say Harley’ as it went down the street. They used a lot of clay models to design a concept bike and they made sure that they stuck with the Harley Davidson style. They used many computer-design programs to come up with 3D modeling. The team had to focus on keeping the Harley Davidson look while ensuring that the bike had the speed of a dragster bike.

The bike spent a lot of time in the prototype and fabrication stages. To make the design thought up by the designers, the bike would have had to have about 17 welds, greatly decreasing the strength of the bike frame. The engineers took awhile trying to figure out a solution until they came across a metal forming technique called hydroforming. Hydroforming works by using water at high pressures to shape metal into curves, which welding did for the most part. This greatly increases the strength of the metal in the frame by cutting down the welds to about seven welds. There was also a problem with the exhaust system. The EPA standards were not coinciding with the volume they had on the bike. On a bike with an engine as powerful as the V-rod, there had to be an exhaust that had a total of about 12 liters and the two part exhaust did not hold enough for the bike to meet standards. They then added the third volume to exceed the volume requirement. The bike also had a problem with installing the radiator and making sure it would get enough airflow to cool the engine properly. The wheel was blocking the flow of air, so the engineers put fins to corral the air in and chop it up so it would flow into the radiator and not past it, a problem that was observed in early testing. Another part that was changed from early Harley bikes was the placement of the engine and the material it was made out of. Since the radiator and engine took up the forward part of the bike, the fuel tank was moved to the back of the bike, specifically the under the seat. There was another problem though. The tank was too small if they used regular metal. The idea came forward to use a plastic because it can be molded and fit into the spot, giving maximum fuel storage. The final total was about five gallons, so the idea paid off.

The hardest part was the engine. The Techs at Harley Davidson were not getting the engine off the ground. They requested the help of Porsche, a well known performance car company based out of Germany. A mixed task force worked on the engine until they got one up and running. The Porsche part of the team then put it through a 40,000 mile test until it worked and that was the finished bike engine. Once all the parts were prototyped, they were put through elemental and riding tests to see if they would break. Once all the parts were proven to hold up to the elements, they put them through riding tests that consisted of idling for parades or going on 80,000 mile test to truly tests it metal. The bike passed the tests and was put through one final batch of tests. The bike was tested against multiple sound frequency such as AM, FM, and cellphone frequency to ensure that the electronics didn’t get shorted out. The bike was also
drench with water to ensure that there was nothing leaking and no water seeped into the electrical wiring. The Harley Davidson team tested the bike against the heat to ensure that the bike wouldn’t overheat during a parade or other idling situations. They also tested the bike to ensure that the motorcycle sounded like a Harley and followed all noise regulations.

Communication was key during the building of the bike. The design team had to communicate with the engineers to get a functional but beautiful bike. They had to work together, not alone. After the bike was completed, they had to come up with a name for the motorcycle. The top staff wanted a unique name that would stand out and did not share a name with anything else. They wanted their bike to be the mental picture that was in your head when the name was said. They combine the name from VR 1000 and hot rod to form V-Rod. They built a brand new facility to mass produce the new V-Rod motorcycle. They revealed the new bike at the Harley Davidson show in Las Vegas, Nevada and the bike was a big hit.