The Design Process Behind the Harley-Davidson 2001 V-Rod

I. Recognize the Need

Consumers of motorcycles began to want bikes that were designed for speed and a sporty look. As other companies began to produce bikes that fit the wants of the consumers, Harley-Davidson was soon left behind with no answer to the emerging market. Knowing that they needed to create a faster motorcycle and keep to the traditional style of Harley-Davidson, the designers and engineers formed a completely original design. With plans to use the engine from their performance racing bikes to compete with bike speeds of other companies, Harley-Davidson had to create a bike from the ground up. With newer technology in the automotive industry from liquid cooled engines to water pressure bending the V-Rod was able to come to life.

II. Define the problem

The Harley Davidson Company needed to build a motorcycle that not only had the power of competing sport bikes, but still had the look of a Harley Davidson. This proposed multiple design challenges because the normal Harley Davidson frame and bike design could not handle the high power VR 1000 engine that the designers wanted to incorporate. This means that they needed a completely new frame and body design but still make it look like a tradition Harley Davidson Factory Custom. Other problems with later prototypes were the size of the fuel tank, size of the exhaust, and radiator styling.

III. Gather Information

In order to get the desired result of functionally and an aesthetically pleasing design, the team needed to find a more powerful engine that they would be able to use in their new bike. Members of the team saw the drag racing bikes and their liquid cooled engines and thought that would be a beneficial thing to incorporate into their next bike. They would need to be able to fit the liquid cooled engine into the frame of a street bike. This was attempted using the traditional frame, but it was not strong enough to hold this particular engine. The designers and engineers started gathering information from other custom bikes and drag racing bikes to try to figure out how they would make a frame that could handle the engine.
IV. Generate Conceptual Ideas
A balance of art and science was needed to complete this project so ideas needed to be bounced back and forth between designers and engineers. The teams realized that the single rail support system would not work with the new engine so they came up with the idea of a double rail system. Another problem they faced with this however was that the two rails needed to each be made by more than one piece of pipe so the stability would be compromised. They used a relatively new process of using water to bend the pipe from the inside and were still able to have full stability in their support rails. The next problem they faced was cooling the engine. They needed to keep the radiator small to not disturb the overall design, but it still needed to be able to do its job effectively. They came up with the idea of using fins on the sides to act as vortex generators to get more air flow. The fins helped to catch the air that was being pushed aside by the front of the frame. They first realized this idea would be useful by testing fins made with cardboard. The team then realized that the standard steel gas tank would not be practical in this bike because it would only be able to run for about 50 miles. An idea was brought up to use a plastic gas tank because it was easier to mold to fit into every nook of the frame and maximize the space available for gas.

V. Compare, Combine, and Select Ideas
Compromise is a huge aspect of the engineering process, especially when it comes to the designs and ideas. In the Harley-Davidson V-Rod, one of the first main ideas that Harley-Davidson wanted to incorporate was the liquid cooled 115 HP race engine used by the Harley-Davidson racing team. They compared using this idea to using the traditional air cooled bikes. They chose to use the liquid cooled engine as it was more powerful, even though it would need a bigger and stronger chassis as well as new parts such as the radiator. They also had to compare the different types of tail pipe designs that they could use. The bigger pipes were needed to muffle the sound better and conform to US road and emissions regulations, but they look very ugly as they are so big. On the other hand, if they used the smaller current pipes, the bike would be too loud. They combined the best from both ideas to create a dual exhaust system. This allowed for the required amount of air to be in the pipes to muffle the noise to acceptable levels whilst still keeping the sleek and slender look that the designers wanted. Not all of the ideas were able to be combined like the aforementioned. Sometimes, a complete redesign was in order.

VI. Analyze and Design
The chassis was a major area of redesign and compromise. Namely, they bigger engine demanded the use of a sturdier frame and thus Harley-Davidson decided to use aluminum as the material for the frame as it is a sturdier and lighter material than the steel that was currently being used. The material was not the only thing that changed, to accommodate the bigger engine, instead of being one spinal support bar running under the gas tank, they had to compromise to use the bigger engine and had to redesign it so that there
were two support bars instead running around the outside of the gas tank. The gas tank was a huge area of concern as the simplistic tanks that were currently being made would be unable to hold more than a gallon of fuel which would make for a very short ride. The engineers were able to design a bigger plastic tank that would be able to hold 4.5 gallons of fuel as it was easier to mold the plastic than to fold and weld the metal. As the main inspiration for the V-Rod was the racing and custom drag racing bikes, the Harley-Davidson team had to figure out how to give the rider the long steering column control as well as the short steering column speed and compactness. The engineers designed a steering column that was slightly more upright than the long drag racers’ columns, and that added angle was able to provide more control for the V-Rod that the drag racers simply did not need. The last major part that underwent extreme iterations of redesign was the new radiator that the bike had to have for the liquid cooled engine. The engineers added vortex generators to radiator as without them, the air was sweeping by the coolant tubes too quickly to truly cool them down. With the vortex generators, the air was stirred up so that the air was forced to interact with the coolant tubes for longer. Thus the radiator was then able to dissipate more heat. After all the designing was done, Harley-Davidson was finally able to start beginning to create large models and even working prototypes.

VII. Fabricate and Test Prototypes

The earlier prototypes that Harley-Davidson made clearly defined what major problems the designers would run into whether it be with fitting fuel tanks or needing bigger exhaust pipes. The design team used a clay model to easily mold a 3D design of the bike they were planning to create as new ideas were being introduced. After numerous prototypes were analyzed and tested, Harley-Davidson soon had a bike that fit the criteria they originally set in the beginning of the product. With every prototype test, the team painted the motorcycles completely black to discourage the public from knowing about their project. With the final prototypes, they began to put the bikes through tests to determine the performance and durability. A series of test included the Dusseldorf test, engine heating test, weather test, suspension and durability test, radio interference test, sound test, and the individual part stress test.

VIII. Communicate the Design (verbally, graphically, and written)

During the 2001 Harley Davidson Dealership Show the first V-Rod Motorcycle was revealed. This reveal and showing at the popular motorcycle show was preceded by a rigorous ad campaign that describe the new innovations and additions to the traditional Harley Davidson cruiser. In addition to the original TV and online ad campaigns, there was a campaign featuring American Super Model Marisa Miller posing in front and on top of the new motorcycle. Over the past several years, the V-Rod has gone through several different redesigns to accommodate customers with different needs and desires.