Recognize the Need

The need for the V-ROD was determined by Harley-Davidson when the company realized it was losing market share to the competing sports motorcycle corporations. The new technology and speed of the sporty motorcycles was drawing the customers away from the old design and style focused Harley-Davidson motorcycles. The new bike was destined to take a slot in the sports bike market, but was also to have an unprecedented design that would serve as a hybrid between a sporty motorcycle and a classic Harley cruiser.

Define The Problem

In addition to recognizing the need for a new product, the employees at Harley-Davidson also realized the issues that went along with designing a motorcycle from the ground up. The engineers and designers set out to build a motorcycle that was completely different from anything they had built before, but that was easily recognized as a Harley-Davidson. This, they hoped, would gain them more market share in the performance oriented sector of the motorcycle market. The main issue at hand was the fact that the engineers had to start from scratch and begin to build a motorcycle that was unprecedented. This in itself was challenging because the engineers essentially had to develop every part in different ways to accommodate the new design needs of the bike. The engineers also had to work with the artistic designers in the collaboration of the development of the V-ROD. This proved to be stressful because the designers wanted to design parts of the motorcycle in ways that sometimes were not possible.
Gather Information

In order to begin engineering the new motorcycles, the engineers and designers had to do their research. They took close looks at bikes produced by different corporations, as well as the dragster bikes that the company had previously produced for speed. They had to investigate the strengths and weaknesses of different materials and different parts that would be used on the bike. All of these different applications would be considered in the development of the new motorcycle. As far as the engine was concerned, the team decided to use their VR1000 racing engine in the new V-ROD. They were forced to gather information about how to fit the engine into the framework of the new motorcycle, and how to make the VR1000 reliable and long lasting. For example, the VR1000 was specifically designed to run races and would rapidly wear out due to the high speeds and revolutions needed for the demanding races. All of the information they needed took time to obtain, but was a crucial step in the production of the V-ROD.

Generate Ideas/ Compare and Combine Ideas

Quickly losing ground to the newer faster bikes, Harley was presented with the challenging issue of taking their original Harley design and incorporating a VR1000 engine into its frame. Quickly finding out that the old chassis would not be capable of holding the newer engine, Harleys engineers and stylists went back to the drawing board to create an entire new line of motorcycles. However, through this entire process they did not want to lose the sound or feel of the original Harley, creating a plethora of challenges. Back at the drawing board, new ideas were spilling out everywhere. With Willys magic, a new motorcycle began to take shape. Willy decided the new motorcycle would incorporate a radiator, double exhaust, double rail frame, aluminum finish, radiator, etc. As the styling department was dreaming up the new line
of motorcycles, they were forced back to the drawing board as their engineers discovered that some of their designs were not possible. Struggling to meet stylings needs, Harley's top engineers sought help and collaboration from Porsche. With a new partner in the mix, many ideas were available for the new line of motorcycles. However, Porsche was challenged with their own problems as Harley asked them to create an engine with specific specifications for the new V-ROD. The new radical ideas presented by Willy and his team tested the limits of current technology. The materials and designs of the frame, exhaust, and radiator all were built to complete the necessary tests and regulations the state required. Although the ideas all seemed possible, little did they know they were still years away from completing this complex new line of motorcycles.

**Analyze and Design**

With the new design constructed and confirmation from engineering that the design could be met, the team was confronted with the issues of discovering what materials would not compromise the original look and feel of the legendary Harley. The design needed to fulfill customers' wants and needs for the new generation of motorcycles, while still staying within the necessary regulations. While design had many innovative ideas, not many engineering applications could be used to make these ideas reality. The new engine required the engineers to acquire a new location for the gas tank from the front of the bike to under the seat to accommodate the new air intake of the engine. Additional issues emerged with the numerous new parts being packed into the new chassis. This meant that all the new fabrications would either need new locations or new looks to maintain Willy’s dreams for the new bike. For example, the new radiator presented a challenge on its own because design needed it hidden from the chassis of the bike. Engineering took this request and used a vortex generator to allow the air
into the radiator to cool the engine of the motorcycle. Many advanced techniques were adopted
by the engineers at Harley in order to meet the necessary specifications for the new bike. After
the constant setbacks, the team was able to eventually converge on a common vision. By this
time the first prototype was ready for its maiden voyage.

Fabricate and Test Prototypes

The team of Engineers went through the process of building a prototype that they knew
would be far from the final product in appearance. They constantly had to adjust the bike’s
mechanics for aesthetic purposes. It was a struggle to please designers while following laws of
physics. For example, the design of an effective cooling system that did not tarnish the overall
clean look of the bike. At times, they used cardboard box pieces to test fins on the radiator that
allowed the air to flow inward during one of the tests in a windtunnel. These conflicting design
elements lead Harley to test new materials that are not generally associated with Harley bikes.
For instance an aluminum body and plastic fuel tank.

A crucial part of the redesign process is testing all features on the bike to find any
potential weak links. All parts on the final design were tested beyond real world applications.
They did this by inflicting damage on parts and performing long test rides at numerous test
facilities to ensure long engine, suspension, and material life. The team also needed a way to
develop parts that were structurally sound, yet capable of being molded into the shape needed to
satisfy the bike’s design. They used a special technology that utilized water to bend the frame
metal and reduce the number of welds needed from 17 to 7. They were able to improve the
efficiency of production and still manufacture satisfactory parts.
Communicate the Design

The final, and quite possibly, most important part of the design process, was showcasing the newly designed bike. V-ROD was released at the Harley-Davidson Convention and advertised in multiple television advertisements, magazines, and in the Discovery video viewed in our Engineering Design course. The V-ROD was truly an engineering masterpiece that the entire team was proud to have developed and built.