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CAPTURING THE ESSENCE OF A PRODUCT'S BRAND THROUGH A SHAPE GRAMMAR REPRESENTATION

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Abstract

Developing and maintaining a consistent brand statement is an important aspect of developing a successful product. However, maintaining that statement is difficult due in part to the inconsistent and often insufficient understanding of brand by marketing, engineering, and industrial design. Shape grammars provide a method for encoding the key elements of a brand into a repeatable language. This paper presents general methods by which shape grammars containing brand knowledge can be used. One of these methods is applied to incorporate the new features of an evolving brand language into a previously defined shape grammar.

Keywords: shape grammars, brand, logic of design

1. Introduction

Developing and maintaining a strong brand is key to a successful product or series of products. An important quality of a strong brand is the presence of a clear, well-defined brand identity. The brand identity is the set of desired associations with the brand that strategists working with the brand wish to establish and maintain [1]. While the brand identity is a combination of factors, none of which can be ignored, it is the product itself that expresses the essence of the brand with its form, function, and interaction with the user [2]. However, many participants in the development of a product, in particular engineers, have little understanding not only of the product brand, but in general what a brand really is. Instead of recognizing that the product is core to a successful brand, they leave brand for the marketing department. When engineers are given a product to detail for manufacturing, their lack of brand understanding may lead to product modifications that negatively affect the consistency of the product. Even the industrial designers who are creating the fundamental form of the product do not always understand the essence of a brand, and explore changes that are counter to the heritage of the brand and brand personality. Deviations from the brand identity may be an appropriate choice for the product development team to make, however the decisions should be made in an informed manner, recognizing what constitutes the product's brand identity.

Our thesis is that there is a logic to strong product brand that can be discretized, captured, and replicated through the shapes that define the product's features. Further, we propose that shape grammars [3] are an ideal candidate to represent product brand and aid in the generation of products that meet a given brand. Shape grammars have been used in product design to capture and represent coffee makers [4] and have been used to explore the representation of product brand of Buick automobiles [5] and Harley-Davidson motorcycles [6]. From this work we believe that shape grammars are the representation of choice because they are a production

system that: 1) directly models a parametric geometry, 2) operates directly on geometry to generate shapes, and 3) provides emergence of shape that can lead to creative design solutions. These properties are critical to concisely modeling a brand identity.

This paper outlines methods by which shape grammars containing brand knowledge can be used for synthesizing products in the brand language, communicating about brand, and understanding brand. These methods are described in context with the Buick and Harley grammars and are used to examine the relationship between the Harley V-Rod to the existing Harley grammar.

2. Shape Grammars

Shape grammars originated in the architectural field from work done by Stiny and Gips [3]. Shape grammars were used to capture the style of Queen Anne houses [7] and articulate the rules of Frank Lloyd Wright's prairie house [8], among other applications. Shape grammars can be classified as a production system [9] containing all of the necessary parts, objects, system definition, and an interpretive mechanism. A shape grammar rule takes the form of $A \rightarrow B$, where A and B are both shapes. The rule is applicable to a shape C if there exists a transformation τ, such that $\tau(A) \leq C$, where $\leq$ is the operator that determines the existance of a subshape. The rule is then applied by subtracting the transformed instance of shape A from shape C and adding a similarly transformed shape B, $C - \tau(A) + \tau(B)$.

Shape grammars offer more than a combinatorial production of shapes as a result of rule applications. The interpretive mechanism of shapes combined with the properties of shape addition allow for the emergence of shape, which is the key to generating creative designs from a fixed set of rules [10]. An example rule as well as an example of emergence can be seen in the classic shape computation of Stiny [11]. The rule in Figure 1 is applied nine times in Figure 2, beginning with shape a. Shape a is composed of three triangles, but as the sequence is computed, the number of triangles changes. Shape d in Figure 2 has an ambiguous number of shapes as does shape f while shape e consists of a pair of triangles. In all three of these shapes (d, e, f), new triangles emerge to provide new directions for rule application. Without subshape recognition the creativity in this sequence would not be possible.

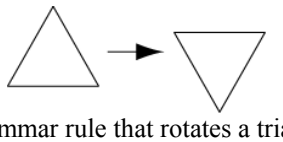
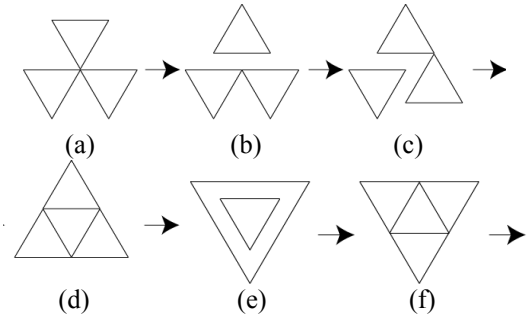


Figure 1. A shape grammar rule that rotates a triangle about its center.



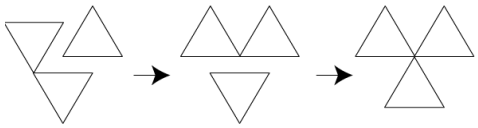


Figure 2. A sequence of rule applications from Stiny [11].

Parametric shape grammars are an extension of shape grammars in which shape rules are defined by filling in the open terms in a general schema. An assignment g which gives specific values to all the variables in α and β determines a shape rule $g(\alpha) \rightarrow g(\beta)$ which can then be applied on a labeled shape to generate a new labeled shape.

3. The Buick and Harley-Davidson Shape Grammars

Recently, shape grammars have been used for engineering applications to model MEMS devices [12] and inner hood panels [12] as well as product design applications to represent coffee makers [4]. The newest application of shape grammars has been to model brand identity through the visual qualities of its products. Two brand-based shape grammars, the Buick [5] and Harley-Davidson [6] grammars, were created to capture the elements that represent the brand essence.

The process of creating the rules requires the designer to examine one or more instances of the product from its past. Shapes of components are examined over the product's history, looking for consistency of brand personality, which is expressed through the form. The shapes expressing the brand identity may change over time according to changes in technology or consumer trends but should consistently reflect the essence of the brand. By grouping similar shapes together, single representative shapes can be used to create a parametric rule that defines a component from certain eras. For example, the rules in Figure 3 represent the general shapes of the Buick grill throughout its history. The grill in Figure 3a represents the grills of the 40's, 50's, the 90's, and the concept vehicles of recent years. The grill in Figure 3b represents grill shapes of the 60's, 70's, and 80's. Once completed, the brand-based shape grammar can be used to synthesize new designs in the language that it defines, as a basis for new products.

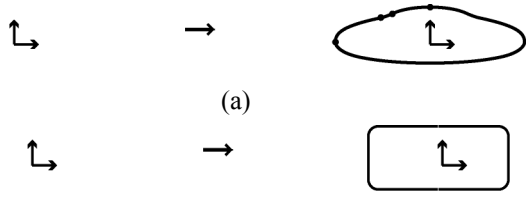


Figure 3. (a) The rounded grill featured in the 40's, 50's, 90's, and recent concept vehicles. (b) The rectangular grill featured in the 60's, 70's, and 80's. From [5].

Both Harley and Buick are examples of brands which have maintained a strong identity. Harley and Buick differ, however, in that the product form of Buick throughout its history has changed more than Harley's. Buick's look evolved with changes in styling chief, changes in technology, and as fashion changed. Generally these changes supported the brand essence as a reliable, comfortable car built on American values. More recently, styling has once again began using shapes that hearken back to traditional designs, which can be seen in the shape grammar rule

shown in Figure 3a. This rule allows the user to generate a grill shape that is both indicative of the current grills and of the traditional grills of the 40's and 50's.

Unlike Buick, Harley has maintained a high degree of consistency of form since its revitalization. Harley's personality of freedom and rebelliousness was renewed with a return to the form of their product's heritage. Again similarly shaped components were grouped together to form a single representative rule. Rules are included to generate the various Harley styles as well as Harley staples, the teardrop gas tank and the V-Twin engine. Figure 4 shows the rules for generating these primary visual elements of the brand.

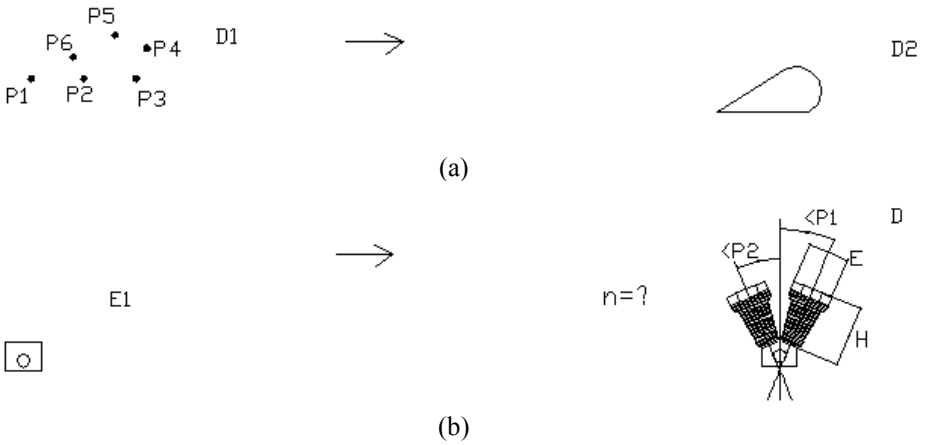


Figure 4. (a) The rule that creates the teardrop gas tank. (b) The rule that defines the V-Twin engine. From [6].

We have defined three ways in which shape grammars containing brand knowledge can be used in various design activities: as a tool for 1) synthesis of artifacts in a brand language, 2) communication involving brand, or 3) understanding brand identity. These paradigms are useful for exploring products within the brand language, defining or redefining the brand language itself, and simply understanding the physical representation of brand identity.

Using brand-based shape grammars as a tool for synthesis is the most straightforward application, as the primary function of a shape grammar is a formal synthesis method. Engineers or designers can work interactively with the grammar, selecting rules and choosing parameters, to define geometry and build a product. For this application, the grammar would already be established and the user is free to explore the language of shapes with the guarantee that the results reflect the core essence of the brand and are feasible from a manufacturing and engineering standpoint. Experiments of this nature were performed to create vehicles that embodied the core essence of Buick while also exuding personality traits not commonly associated with Buick. Figure 5a shows a rugged Buick SUV created with the grammar while Figure 5b shows a sporty Buick design.

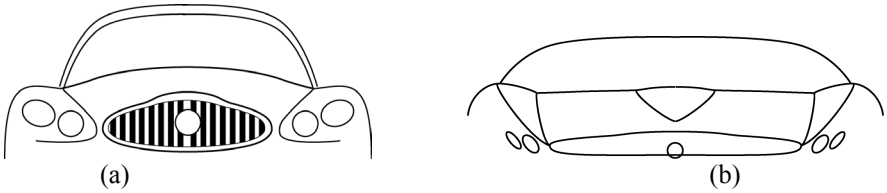


Figure 5. (a) Rugged and (b) sporty designs created with the Buick shape grammar. From [5].

The second way in which brand related shape grammars can be useful is as a tool for communication. Shape grammars can provide a common language through which design, engineering, and marketing can communicate about the product and specifically about the product as it relates to brand. One scenario involves engineers expressing manufacturing and engineering constraints to design through a grammar. Designers can then work with the grammar created by engineering to impose restrictions on the language based on brand. This process would be iterative with the results being a language that contains feasible products that adhere to a brand identity. This process can also be used to evolve a brand language because of advancement in technology or a change in brand position. Other scenarios of brand communication involve marketing using studies or surveys with consumers to gauge perception of the brand image. Information could be obtained, linking a shape or feature with the emotion it evokes in the user. Tying an emotional descriptor to a rule or parameter would provide a connection between marketing and design by allowing a rule to be referenced by the feeling that it produces through shape.

Pugliese and Cagan wrote the Harley-Davidson shape grammar as a general motorcycle grammar and included a set of constraints that, if followed, limited the grammar to generate Harleys. The scope of the grammar was chosen in order to test the sensitivity of a component to changes with respect to its importance to the brand. Several new designs were generated with the grammar and Harley constraints, as well as designs that did not adhere to the Harley constraints in order to verify the notion of what defined a Harley. This verification was done through a web-based survey. Figure 6 is an example of a Harley generated with the grammar and proper constraints. The survey provided feedback on the consumer's views of Harley products and could be used test or refine the bounds of a brand.

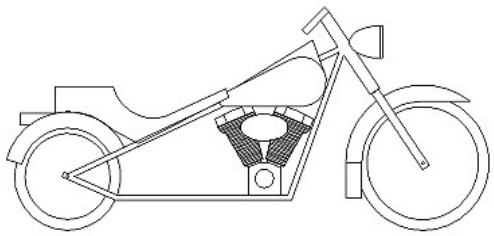


Figure 6. A Harley design created with the shape grammar and Harley constraints. From [6].

The third use of a brand-based shape grammar is as a tool for understanding brand. The grammar can act as a reference library of shapes, accessible in an informal manner or formally, as a set of generative rules. By working through the grammar, a user can gain insights into the shapes that are critical to the visual brand statement. The grammar can also be used for verification of brand identity by searching the brand language for the design in question. Interestingly, shape grammars provide a formal method of shape identification through a special identity rule, A → A [11], where A is a shape. If the identity rule is applicable to a design, the design contains an instance of shape A. If important brand features are represented with identity rules such as in Figure 7, it can be determined if, and to what degree, a design expresses the essence of a brand through its shape. If the rule in Figure 7 is applicable to a design, the design contains a Harley V-Twin engine and can be said to exude the personality of Harley through that

feature. This formal method of identification is used in the next section to examine the Harley V-Rod. The insights revealed can then be used to modify the grammar if necessary.

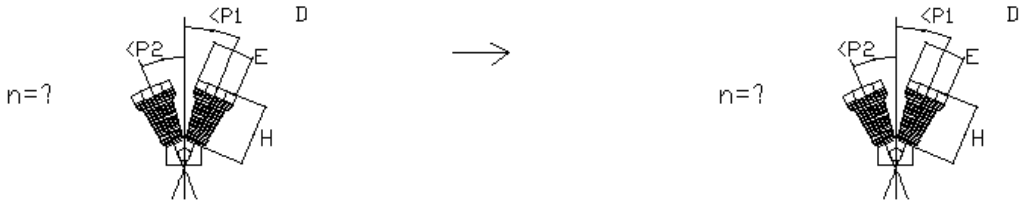


Figure 7. The V-Twin identity rule used to evaluate the visual brand qualities expressed by a shape.

4. The evolving brand language of Harley-Davidson

Harley-Davidson recently began producing a motorcycle called the V-Rod. Harley identified that younger riders demanded performance motorcycles, capable of high speeds and acceleration, as is found among many competitors. The challenge was to create a new product that appealed to these new consumers while maintaining a connection to the brand heritage, in order to avoid alienating the traditional customer. This challenge fell to engineers and designers, as the product is ultimately their responsibility and is a key method by which the Harley personality must be expressed.

Of the three general uses of brand-based shape grammars, synthesis and communication of brand knowledge are most useful for defining new products and grammars encapsulating those products that may be outside an existing language. For example, this combination of methods would have been beneficial for designing the V-Rod, when starting with only the original Harley grammar. However, in this study, we are simply evaluating a new product with respect to an existing grammar and potentially altering the grammar to capture new embodiments of brand identity. This application can be classified as the third general use of brand-based shape grammars, understanding brand. Using the motorcycle grammar as a library of shapes, a representation of the V-Rod can be generated in the style of the existing Harley grammar. This representation (Figure 8) is a two-dimensional line drawing using the same assumptions and level of detail as other motorcycles represented in the grammar.

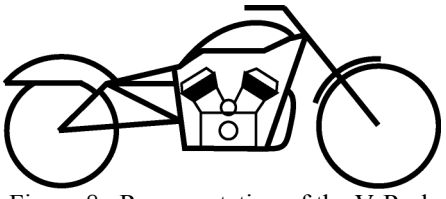


Figure 8. Representation of the V-Rod.

This design can be evaluated by searching for the shapes that are primary to the brand as defined by the original grammar. This can be formally expressed as an identity rule (A→A) for the V-Twin engine (Figure 7) and the teardrop gas tank (Figure 9). The V-Twin can be located, but the parameter indicating the angle of the V-Twin is 60^{o} for the V-Rod while the Harley constraints in the grammar limit this angle to 45^{o}, the angle between cylinders of traditional Harleys. A strict search for the teardrop gas tank produces no results. These identities indicate that, assuming the

representation is sufficient, either the V-Rod is not a Harley based on its visual statement of brand or the Harley grammar is incomplete and requires modification to properly represent the evolved brand language. Arguments can be made on behalf of these changes based on the fact that the brand identity is still preserved and that the modifications to the shapes of elements expressing the brand are necessary due in part to technological changes to the motorcycle. The seat, wheels, fenders, front fork, engine, and headlight are all represented in the original grammar. The frame and gas tank representations are incomplete while the radiator is not represented at all. The goal is to create new rules to describe each of these components, which then could then be incorporated into the motorcycle grammar, resulting in an updated brand language.

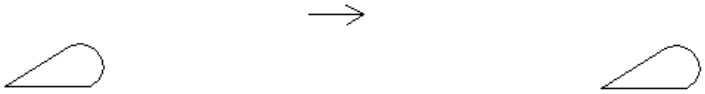


Figure 9. The identity rule for the teardrop gas tank.

Rules are needed to define new frame geometry in order to encapsulate the style and function of the V-Rod frame. The grammar can produce variations of the frame topology in Figure 10, known as the soft-tail. This frame type serves as the basis from which the V-Rod frame is derived. Components are labeled shocks, frame, or swing arm for clarity. Additional rules must alter the positioning of the swing arm box in the engine and add support in the rear. Some general rules for accomplishing these tasks in the grammar are suggested in Figure 11. Combined, these rules allow frames to provide sufficient support over the new stretched length. The results of applying these rules to Figure 10 are shown in Figure 12.

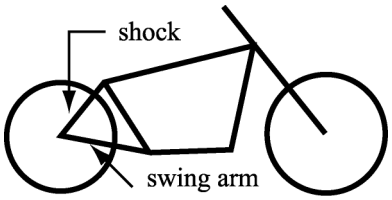
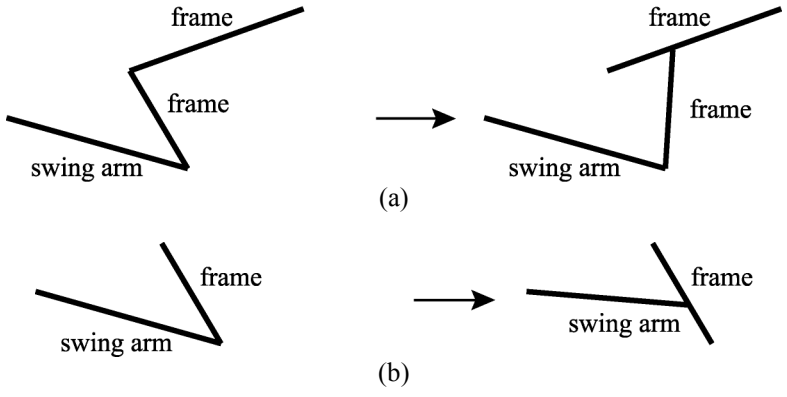
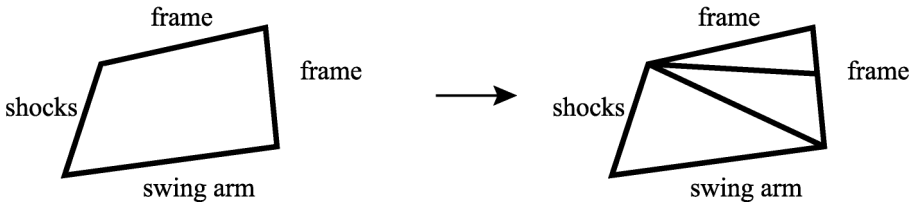


Figure 10. Topology of soft-tail frame generated by original motorcycle grammar.





(c)

Figure 11. Rules that (a) move frame support towards he engine (b) move location of swing arm connection to frame (c) provide additional support in rear end

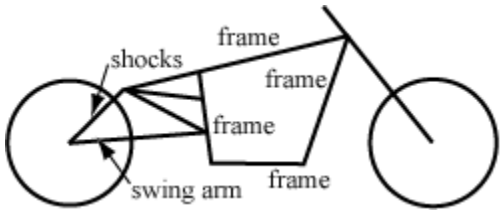


Figure 12. Results of applying rules in Figure 11 to shape in Figure 12.

The radiator, made necessary by the liquid-cooled engine, was prominent on other brands, which have featured liquid-cooled engines for many years. Typically (if not always), radiators were attached to the front of the frame, appearing as a black box. In order to modify the language described by the motorcycle grammar to include liquid cooled engines, a rule creating this feature is necessary and is shown in Figure 13. Harley-Davidson approached the radiator as a component which should not only be functional but have aesthetic value as well. Most of the ornamentation on the Harley radiator cowl is only seen from a more detailed front view, but its profile is unique among motorcycles. It is important to represent the radiator cowl in the grammar because it will undoubtedly be a primary visual element of the brand in future Harley-Davidsons featuring liquid-cooled engines. The rule for generating the Harley radiator cowl is in Figure 14.

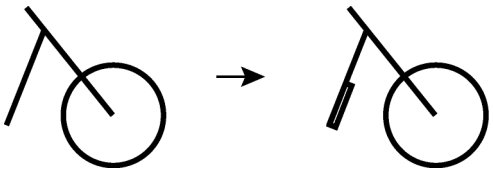


Figure 13. Rule for creating a typical box shaped radiator.

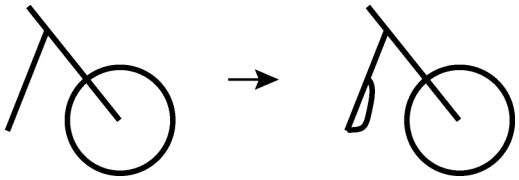


Figure 14. Rule for creating the styled Harley radiator cowl.

The gas tank has traditionally made a very strong brand statement. Teardrop shaped and made of steel, it has identified the Harley brand and has been copied by competitors trying to establish a similar rugged, rebellious personality for their motorcycles. However, the new engine required access to air directly above it, which dictated a change to placement of the gas tank. In order to maintain the teardrop look, designers added a cowling, shaped like the visible portion of the tank, to where the gas tank had once been positioned. The cowling provided a void from which air

could be drawn. Engineers then fabricated a new plastic gas tank that is located below the seat. Two rules were created to model the new embodiment of the teardrop. The rule in Figure 15 eliminates the representation of the bottom portion of the tank that extends below the frame. This is only applicable for the teardrop functioning as a cowl. The second rule (Figure 16) alters the shape of the frame where the cowling and frame connect in the style of the V-Rod. While not an important brand characteristic itself, it provides an attractive transition from cowling to engine. Other rules could be added to further enhance the aesthetics of the frame, as is Harley's goal with that component.

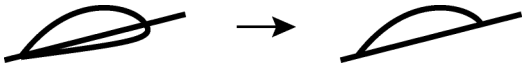


Figure 15. Rule that eliminates the representation of the lower portion of the teardrop.

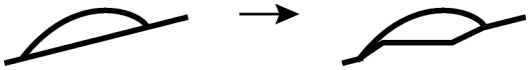


Figure 16. Aesthetic enhancement to the frame as is seen on the V-Rod.

Based on the new teardrop cowling, the identity for primary Harley features should be rewritten to recognize only the top portion of the teardrop (Figure 17). This rule is now applicable to all Harleys making it a necessary, but not sufficient, condition for the modern Harley. A change in the constraints on engine cylinder angle should also be implemented to allow 60^o in addition to 45^o. Only allowing 60^o to be a valid parameter selection when the liquid-cooled engine is chosen would be appropriate.

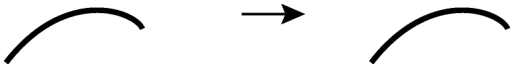


Figure 17. The teardrop shape that is required of all Harley designs.

5. Concluding Remarks

It is clear that a strong brand is important to a successful product. Maintaining the brand in a consistent manner, yet still allowing products to evolve, can be a challenging task. Using a shape grammar to encapsulate the brand identity through the product form gives engineers and designers a tool which can be useful for synthesis, communication and understanding of brand.

The introduction of a new product under an existing brand tests both the completeness and correctness of the grammar describing the brand and the consistency of the product. This process of extending a grammar has been used before. During the creation of the Buick grammar, the span of designs covered by the grammar increased several times. The grammar, which originally described modern Buicks, was first extended to include Buicks of the sixties and seventies and later to include earlier Buicks and recent concept vehicles.

Visual brand characteristics introduced and modified in the Harley V-Rod appear to be both minor and justified. The cooperation of engineering and design preserved key brand elements, such as the teardrop, despite a radically different function. The previously published Harley shape grammar, which was created prior to the unveiling of the V-Rod, required only minor changes to encapsulate the new product. This indicates that the brand essence originally

captured in the Harley grammar was valid and is in fact, reinforced by the visual qualities that Harley continues to exude.

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